THE

ELECTRICAL REVIEW.

VOL. XLVI. FEBRUARY 16, 1900. No. 1,160.

CONTENTS:

	PAGE
Electrical Contracts and Contractors	253
Electro-Deposition of Copper from Alkaline Solutions (*illus*) ...	255
Standard Electrical Plant	256
The New York Rapid Transit Tunnel (*illustrated*)	257
Legal:—Rucker *v.* The London Electric Supply Corporation ...	259
Correspondence:— Inductor Alternators (*illustrated*)	261
The Use of Rubber-Insulated Wires in Steel Conduits ...	261
Paralleling Single-Phase Alternators	262
Departure of Electrical Engineer Volunteers for Service in South Africa	262
Hoepfner's Carbon	262
Deficient Postage	262
Friction Losses in Dynamos	262
Mechanical Stokers	262
An Electrolytic Centrifugal Process for the Production of Copper Tubes	263
The Institution of Electrical Engineers	263
Business Notices, &c.	264
Bromley Electricity Works (*illustrated*)	273
Plant of London Metropolitan Electric Supply Co. (*illustrated*)	277
Supply Station Accounts	280
City Notes	281
Traffic Receipts	284
Stocks and Shares	284
Share List of Electrical Companies	285
Market Quotations	286
Institution of Electrical Engineers:—The Standardisation of Electrical Engineering Plant	287
The Legal Status of an Electric Inspector	288
Technical Education in America	289
On the Theory and Practice of Getting Jobs	289
Physical Society	290
Hartmann and Braun's Watt-hour Meter (*illustrated*)	291
The Speed of a Cable affected by the Inductance	291
A Record Performance in Pumping Engines (*illustrated*) ...	292
New Patents	294
Abstracts of Published Specifications	295

THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY. Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4 LUDGATE HILL, LONDON.

Telegraphic Address: "AGENCY, LONDON." Code A B C.

Telephone No. 983 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

***SUBSCRIPTION RATES.*—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 10s.**

***BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.**

***CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each.**

***READING CASES*, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 4s., or Free by Post (in Great Britain), 5s. 6d**

***FOREIGN AGENTS.*—*New York*: D. VAN NOSTRAND, 23, Murray Street. *Paris*: VEUVE J. BOYVEAU 22, Rue de la Banque. *Berlin*: ASHER & Co., 13, Unter den Linden.**

Cheques and Postal Orders (on Chief Office London, to be made payable to Mr H ALABASTER, 4, Ludgate Hill, E.C.

ELECTRICAL CONTRACTS AND CONTRACTORS.

THERE is considerable uneasiness among contractors as to whether there will not be a general attempt to enforce penalty clauses for overdue electrical plant. As the delivery of machinery on the specified date is a somewhat rare event, the matter becomes one of serious moment to the whole electrical industry. No doubt the manner in which the Cardiff *v.* Ferranti case was settled has given a greater degree of confidence to municipalities and other purchasers of machinery, but though the contractors in this particular instance showed a disposition to compromise, there was in no sense a judicial pronouncement on the merits of the case. However that may be, we do know of one instance where a contractor paid the penalties rather than contest the matter in a Court of Law, and those examples of submission are not lost on the municipal mind. Already we hear of one local authority which has resolved to make demands upon the contractor, although the machinery was not more than four months overdue. We should not care to suggest that any municipality would be guilty of an attempt to get a reduction on the price of plant by taking advantage of a contractor's difficulty, but we do think that Corporations would be wise not to push contractors too far. For the sake of argument, it may be admitted that there has been a degree of recklessness among contractors in making promises of delivery, and probably the manufacturer who made the best promise got the order; but apart from one or two bad cases of non-delivery, we doubt whether any contractors could have given short delivery of plant. We know in the face of American competition this is a strong statement, but as a matter of solid fact, are our American friends doing very much better than home manufacturers in the way of early delivery? No doubt it is possible to point to specific instances, and say they are monuments to American punctuality, but equally so one can point to special examples of English manufacturers completing their contracts up to time. On the other hand, we can quote cases where the late delivery of American electrical machinery is causing much inconvenience. The point we wish to emphasise is that it would be impolitic for municipalities to exact their pound of flesh. They may have suffered much inconvenience, and probably some actual loss, but they could never obtain much in the way of compensation, and while they might inflict summary punishment upon a defaulting contractor, the effect on the whole electrical industry would not be favourable. There will be in future, no doubt, as a result of the Cardiff case, a better relation between promise and performance, but the actual deliveries of plant will not for some time to come show any marked

improvement. It means that the contractor will exercise a little more care in making statements, but having learned caution he may go so far as to leave himself plenty if not too much margin.

Probably the great works that are being erected in different parts of the country may ease things somewhat, but we do not suppose they will exert any permanent effect. It is always unsafe to prophesy, but as far as one can see there appears to be unlimited scope for electrical machinery; it is easy to see that much remains to be done in tramways, and comparatively little has yet been done in lighting; moreover, the demand for electricity for motive power purposes will be enormously increased in the next few years, more especially so when the ridiculously high charges which prevail in many towns are brought down. At the present time there is a marked competition of the gas engine and electrical works, engineers are not doing sufficient to enable electric motors to compete on equal terms. Moreover, while small users of power are quite aware that a gas engine of equal power probably costs more to fit up than the electric motor, the heavy first-hour charge kills it. An electric motor is specially adapted for intermittent work, but in some towns if the user only employs his motor one hour per day, he is compelled to pay 7d. per unit. Electric motors ought most certainly to be put on special rates, for the cultivation of the motor load is a necessary desideratum for electricity works.

While upon the subject of contracts and contractors, it ought not to be lost sight of that it is not always the firm which turns out the largest number of electrical machines that is the most prosperous. A contractor may turn out dynamos and motors almost like loaves of bread, but he cannot have reached such a state without incurring heavy expense in special tools, and sometime the question may be raised as to whether he would not have made more money if he had stuck to his old casual methods. We do not say for a moment that works carried on with old-fashioned haphazard methods could possibly compare in efficiency with newly-organised and equipped machine shops, but there is a distinct danger lest too high a price be paid for the extra efficiency. Probably the contractors who make most money in connection with electrical undertakings, are those who supply the small accessories, or even the cylinder oil, or the lagging for the pipes. Their work attracts probably little attention, and for that reason is no doubt the more remunerative.

The price of raw materials, while already influencing the electrical manufacturer, is destined to have a still further effect. Up to the present engine and dynamo builders have not felt the pinch severely enough to demand a very marked advance in prices; but though copper has shown some fitful signs of weakening, there appears to be no immediate prospect of a general fall in prices; the result is, that during the next few months, or even weeks, there may be a general increase in the cost of dynamo machinery. Copper, of course, has a more direct and decisive effect upon the cable makers than upon the machine builders, and in consequence there must have been occasionally contracts which were not remarkable for profit. Although it is not at first easy to see what direct influence the war may exert upon the progress of electrical undertakings, it certainly makes money tight, and, what is more, it takes off the attention of the public from all new schemes.

Smoke Prevention.—So many devices have been foisted on steam users, having for their ostensible purpose the prevention of smoke, that steam users are very apt to doubt anything and everything connected with the subject. Attempts are being made to push a new one which hails from Australia. We say nothing about its merits or demerits. What troubles us is the doubtful method employed by the *Daily Graphic* in describing and illustrating the results it is claimed to give. Our versatile contemporary prints two views, described as based on photographs—not on a photograph—supposed to have been taken of a certain Liverpool brewery. Examination of the illustrations shows that in one case the chimney top is smokeless, and in the other picture a huge black cloud is seen pouring out. The special point in each picture is that the numerous watching crowd is the same in each case—every man, woman, and child in the same snap-shotted attitude, whence we are to conclude that the obliging crowd stood still for a sufficient time to enable a smokeless chimney to send forth a full black cloud of smoke, hundreds of feet in length and enormous in extent. The actual sequence of events was supposed to be reversed; the same argument as to duration of time will equally apply. This is a very improper use to make of photography, for that science is intended to represent things as they are. The *Daily Graphic* of January 17th, 1900, evidently holds a different opinion, and such methods are not likely to conduce to a belief in the articles described.

Since writing the foregoing, we have found another illustrated description, the pictures containing, one a natural looking crowd of one person — the other a crowd of three persons. The description we now find in the *Public Health Engineer* shows the invention to consist simply of a grid bridge and a steam-compelled hot air admission, the danger of which is that too much air may be admitted and cause loss. The description of the furnace action is a farrago of nonsense about superheated nitrogen and heat units, quite unnecessary in a description of what may be quite a useful device.

International Medical Congress at Paris.—The *Times* Paris correspondent says that at the request of the French Society of Electrotherapy and Radiology, the international congress of medical electrology and radiology is to be held in connection with the international congress of 1900. A commission—composed of M. Weiss, professor at the University of Paris, president; MM. Apostoli and Oudin, vice-presidents; M. Doumer, professor at the University of Lille, general secretary; M. Moutier, secretary; M. Boisseau du Rocher, treasurer; and M. Bergonie, professor at the University of Bordeaux; M. Bouchacourt, M. Branly, professor at the Catholic Institute of Paris, and other distinguished medical men in Paris—has been asked to assure its organisation. The congress will take place in Paris from July 27th to August 1st, 1900. All inquiries for further information must be forwarded to Prof. E. Doumer, general secretary, 57, Rue Nicolas Leblanc, Lille. Notices of intention to join the congress are to be sent to Dr. Moutier, 11, Rue de Miromesnil, Paris.

The Glasgow Section of the Institution of Electrical Engineers.—The Glasgow section of the Institution of Electrical Engineers has been constituted by the election of Lord Kelvin as chairman; Prof. Magnus Maclean as vice-chairman; Prof. W. H. Watkinson as secretary; and the following as members of committee:—Mr. W. A. Chamen, Mr. H. A. Mavor, Mr. Lackie, Mr. Andrew Jamieson, Mr. John M. M. Munro, Mr. W. B. Sayers, Mr. Francis Teague, and Mr. Thomas Young.

Nature v. Science.—According to a Dublin paper a live rat and a dead dog lately succeeded in upsetting the even tenour of the electric light and tramways to a marked extent. The former gnawed through the insulation of one of the lighting cables, was duly electrocuted, and short-circuited the mains, thereby extinguishing a number of lamps; the latter floated into the suction pipe of the Ringsend power station, cut off the water supply, and brought about the temporary stoppage of the whole of the tramway service!

ELECTRO-DEPOSITION OF COPPER FROM ALKALINE SOLUTIONS.

By SHERARD COWPER COLES.

One of the most recent applications of the electro-deposition of copper is for the purpose of coating, with metallic copper, zinc sheets, which are used for a variety of purposes.

As copper is precipitated from copper sulphate solutions by simple immersion, it is necessary to use an alkaline solution. The accompanying illustrations, figs. 1 and 2, show a plant that has recently been erected at the works of the Société des Mines et Fonderies de Zinc de la Vieille-Montagne in Belgium, for electro-depositing copper upon metallic zinc sheets.

The plant consists of a tank for removing grease from the plates to be coppered, a hot water tank for swilling the zinc plates after treatment in the soda tank, a tank containing the alkaline copper electrolyte, regenerating tanks, circulating pump, and a brushing and polishing machine.

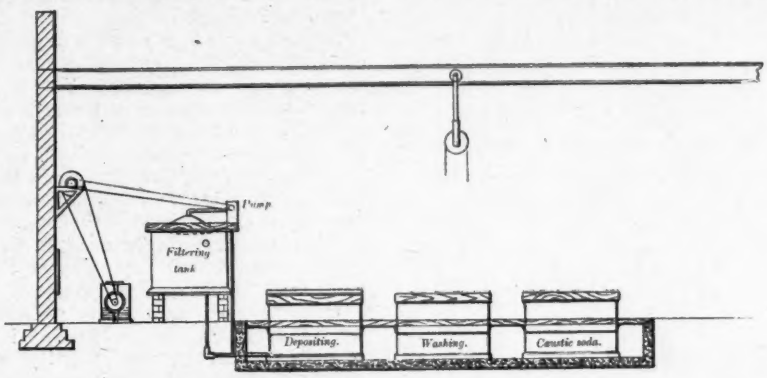


Fig. 1.—Elevation.

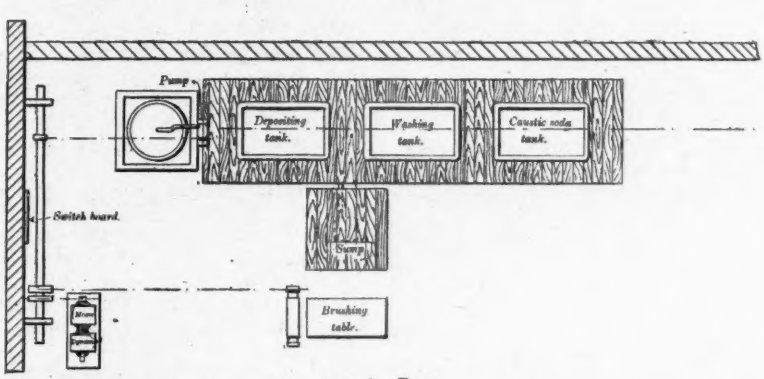


Fig. 2.—Plan.

The zinc plates to be coppered are first of all dipped in the tank containing a hot solution of sodium carbonate, about 1 lb. to the gallon of water. The plates are then well rinsed in the washing tank, and placed in the copper depositing vat, having been secured to dogs fitted to cross bars, which rest on copper strips attached to girders carrying the anodes. This arrangement effects a considerable economy in the first cost of the plant, it also has the advantage of allowing the electrodes to be brought closer together than would otherwise be the case, thus reducing the voltage required. The anodes are of rolled copper, and are bolted to copper strips running the length of the compound anode and cathode bars. Figs. 3 and 4 show the compound anode and cathode bars placed in position on the tank, and the mercury channels at the end of the tank, making the negative and positive connections.

The electrolyte is composed of the double salt of cyanide of copper and potassium, and is worked at a temperature of 150° F., the current density being 10 amperes per square foot of cathode surface, and the voltage at the terminals of the electrodes 1·6. The solution is circulated through the regenerating tanks by means of a centrifugal pump, over a filter bed composed of copper in a fine state of

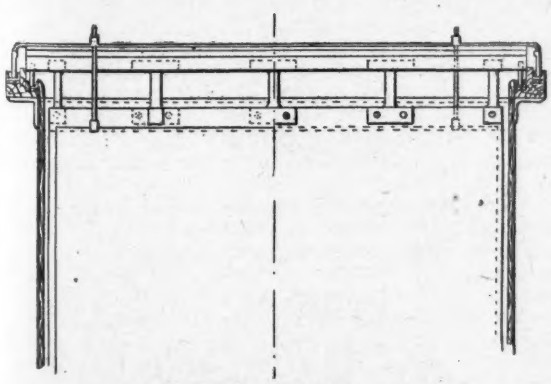


Fig. 3.—Side Elevation.

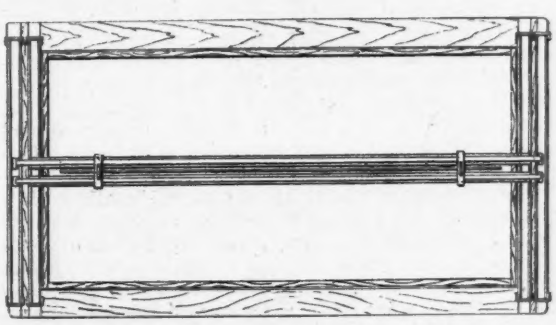
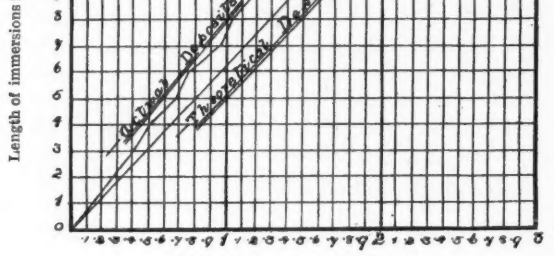


Fig. 4.—Plan.

division. This arrangement is found to keep the bath up to its normal strength, the specific gravity at 15° C. being 1·12.

When the desired thickness of copper has been deposited on the plates, they are removed from the bath, and thoroughly washed in clean water, then polished by passing them between revolving brushes.

Diagram showing Actual and Theoretical Deposit of Copper on Zinc.



Current density = 40 amperes per square foot.
Voltage at electrodes 1·5
Temperature = 100° Fahrenheit.
Solution = 2 lbs. potassium cyanide per gallon of water.
" 1 lb. copper " " "
" 2 ozs. ammonia " " "

Fig. 5.

Fig. 5 shows the actual as compared to the theoretical weight of copper obtained with various current densities, from a cyanide copper solution, to which a small amount of ammonia had been added.

STANDARD ELECTRICAL PLANT.

At this stage of electrical engineering we fear it is late in the day to propose universal standardisation. The mischief is already done, and to a large extent cannot be undone. All the large and important towns in Great Britain have already adopted some system of electrical supply, and these cannot now be standardised. An examination of the table published in the paper read by Mr. R. P. Sellon last week before the Institution of Electrical Engineers, reveals the lamentable fact that hardly any two supply plants are alike; this is the root of the whole difficulty in standardising plant.

In the existing state of electrical affairs, the want of uniformity in such important elements as periodicity, electrical pressure, and steam pressure, precludes any standardising of lamps, motors, meters, &c. Plant suitable for one town is of no use in another a few miles away. It is bad enough to have two distinct systems, continuous and alternating, but it is simply intolerable to find such differences existing in both systems.

The co-existence of two systems so widely different is a misfortune. In the early days of railways, the two ganges, the broad and narrow, were introduced, but time proved the existence of the two to be impossible, and at great loss the broad gauge succumbed. In all probability the fitter of the two electrical systems in use will survive, and no doubt the one which first becomes standardised will have the best chance.

Referring to the table, we have all pressures from 100 to 500 volts, and no less than 14 different periodicities from 50 to 120. In early plants the pressures were limited, by the lamps available, to 100, 110, and 120 volts, and although there was then little room for variety, yet the consulting engineers displayed the same disregard for uniformity to the best of their limited means by adopting different pressures.

The introduction of high pressure incandescent lamps and the rapid growth of business has led to many stations changing from the former 100, 110, 120 to higher pressures. Here was an opportunity for standardising—an opportunity which in all likelihood will never occur again. It was not taken, and now the same old variety exists as before, and we have 200, 220, 215, 250 volts; it is amazing. There is no earthly reason for such differences. Can anyone explain why 200 volts should be used in one place, and 250 in another?

Nothing seems to us to have been easier and more obviously necessary at the very outset than to agree upon uniform pressures and periodicities. Yet we find each engineer acting totally independently on fundamental points.

The early blunders were perhaps excusable, but there is no excuse now for their repetition; that is not the kind of repetition work calculated to encourage business.

It is supposed that electrical engineering institutions and associations exist at least partly for the purpose of discussing and settling such things amongst their members; let us hope that Mr. Sellon's paper may be the means of inducing all of them to take combined action.

Uniformity of pressures and periodicities must begin at the fountain head, the supply plants, if standardisation is to be made possible to any extent. But we are not now likely to see the continuous current supplies in the country converted to one uniform pressure, nor the alternating converted to one pressure and one periodicity. It is too big an undertaking; to change from one pressure to another or one periodicity to another in established plants is a costly step to take, and one feels the pity of it that such simple matters were neglected while they could have been arranged in uniformity without in the least interfering with the interests of anyone. In fact, a uniform pressure and periodicity might have been made compulsory with great advantage.

While the existing state of affairs seems incapable of improvement in this matter of uniformity, everything possible should be done from this time forward to bring about uniformity in new plants. It is a subject for the Institution of Electrical Engineers, among whose members are the very engineers responsible for this lamentable lack of uniformity in pressures and periodicities, to settle to the satisfaction of all.

Turning now to the standardising of manufactures such as those under headings, *e*, *f*, *g*, in the paper, these are beyond the control of outsiders. The manufacturer will standardise as soon as he sees a demand for "ready-made goods"; but so long as he finds the demand is for goods, as it were, "made to measure," he cannot see his way to repetition work.

That is the whole manufacturers' case in a nutshell. Continental and American manufacturers produce and supply "ready-made" machinery all to fixed standards. Our engineers prefer to have them "made to measure"—*their own measure*. And the want of uniformity here is as great a difficulty with the foreigner as it is with our own manufacturers; for many places the ready-made articles are but misfits.

The American manufacturer, as a rule, is better equipped with tools for his trade, makes only one or two specialities, and has no trades union interference to speak of; his ready-made goods are, therefore, cheaper wherever they happen to fit in.

We do not blame our manufacturers altogether; they have had no real chance to adopt repetition work in all cases, but, unfortunately, where it has been possible, they have not always been alive to their own interests. If a manufacturer could make and sell 250-volt motors, and be certain of disposing of them in every town with an electric supply, standardising would be at once possible. At present only a few towns could use his standard article; a fresh standard would be required for other places.

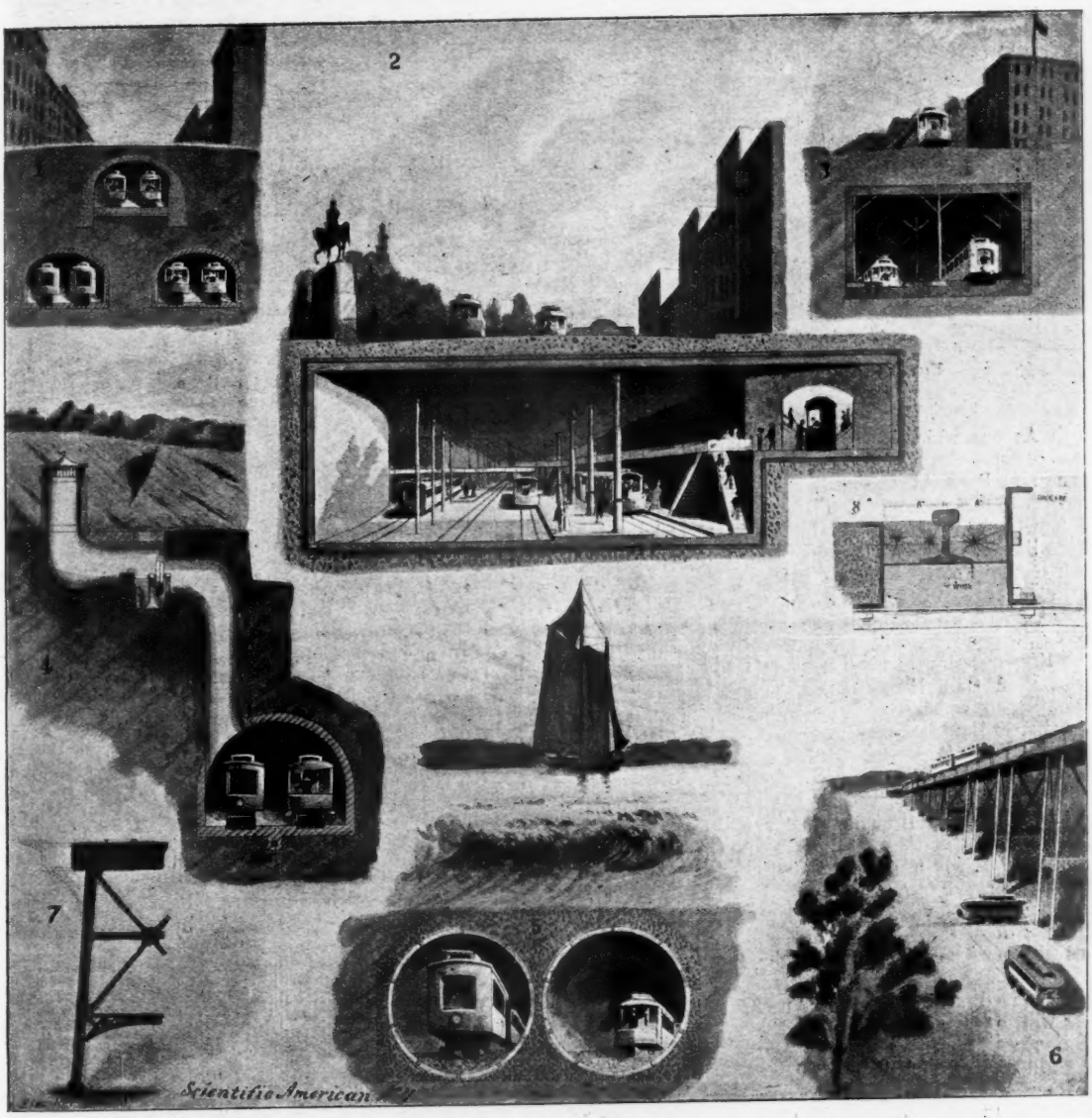
Isolated plants for ship lighting, works, transmission of power, and so on, might very well be all made of the same standard pressures as the public supplies, but in this line of business there are many special cases wherein everything has to be made to measure. Still, there are many instances of

transmission of power where standard dynamos, switchboards, starting switches, and motors should be used. And this could easily be brought about if consulting engineers would but agree upon one common pressure as a standard, and also possibly come to a general understanding upon some standard speeds. It would then be safe for our enterprising manufacturers to carry a stock of ready-made goods.

The questions raised by the paper are eminently suitable for discussion by the Institution, they have been by far too long overlooked, so much so that we might almost say the paper has come "the day after the fair." If, however, it tends to reduce the growing use of plants with no rational standards, it will have served a useful purpose. The standardisation of the plant dealt with by electrical wiring firms is still possible by making them all for the higher pressures alike, so that what is good enough for 250 volts will be better for 110; but to a large extent everything manufacturers could safely standardise has been done in these details, and we cannot see how much more standardising can be obtained in the face of the absurd diversity in the pressures and periodicities of supply. The standard has been set up in each town and city without rhyme or reason, each having a different standard to distinguish them from one another as it were.

What might be considered good standard accessories for Manchester, would, for instance, be no good in Leeds, and accessories standardised for Glasgow of no use in London—all ready-made misfits. Under the circumstances, the discussion of this "domestic question" by members of the Institution should prove of more than usual interest.

It is a subject to be looked into with broad views, not from the point of view of party. The whole of the electrical supply in Great Britain must be considered collectively with a fixed desire of bringing about the same co-operation in electrical work as now happily exists between the Mother Country and the Colonies.



1. The four-track road in two tunnels below the Park Avenue tunnel. 2. Fourteenth Street Station, looking north. 3. Two-track line below Lenox Avenue. 4. Ventilating shaft for tunnel beneath Central Park. 5. Tubular tunnels beneath Harlem River. 6. Elevated portion at One Hundred and Twenty-fifth Street. 7. Details of viaduct construction. 8. Details of track.

New York Rapid Transit Tunnel.

THE NEW YORK RAPID TRANSIT TUNNEL.*

Although the New York Rapid Transit Tunnel is such a really stupendous undertaking, far exceeding in magnitude any work of the kind elsewhere, the details of its construction and the manner of executing it are not so complicated but they may be easily understood by the average lay reader. The accompanying series of illustrations cover pretty well all the main features of the construction, the various views having been selected with the object of showing the general plan which will be followed throughout the major portion

* *Scientific American.*

of the route and the various sections of the road where local conditions call for departure from the general plan.

The route of the road, as shown in the accompanying map, starts from a large underground loop which will be built beneath the City Hall Park. The four tracks within this loop will be carried in two storeys, two tracks above and two below, but at the point of junction between the loop and the main four-track line the tracks will converge to a common level, and will continue at the same level practically throughout the whole length of the system. The four-track road will pass beneath Centre Street and Elm Street to

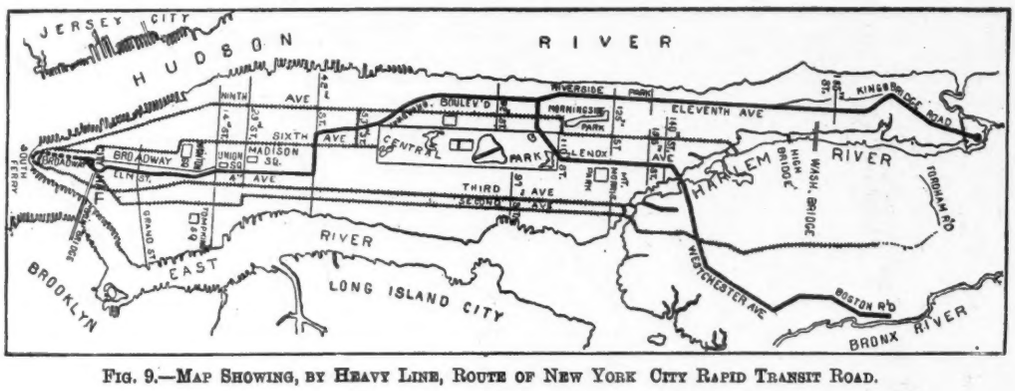
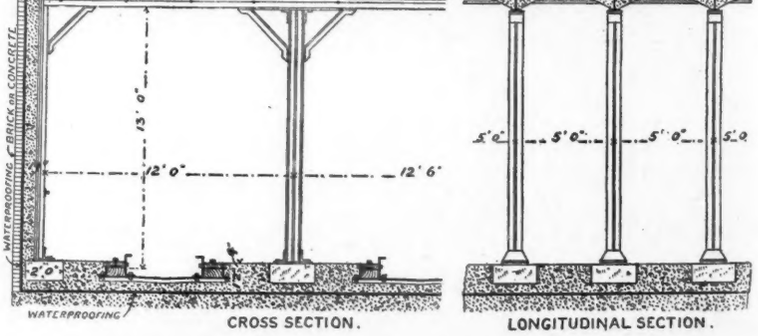


Fig. 9.—Map Showing, by Heavy Line, Route of New York City Rapid Transit Road.

Fourth Avenue, which it will reach in the neighbourhood of Ninth Street. Thence it will continue beneath Fourth Avenue and Park Avenue until it swings to the left into Forty-second Street, beneath which it will run to Broadway. The four-track road will continue underneath Broadway and the Boulevard (now known as the Broadway) until One Hundred and Fourth Street is reached, where the system will divide into two two-track lines. The western branch of the road, which will be known as the West Side Line, will continue along a route which is approximately parallel to the North River, passing through Spuyten Duyvil to the neighbourhood of One Hundred and Thirtieth Street. The eastern branch, which will be known as the East Side Line, will swing to the north-east, passing beneath the north-west corner of Central Park, and running beneath Lenox Avenue to the Harlem River, under which it will be carried in two tubular tunnels. It will then continue in a general north-easterly direction to Bronx Park. The distance from City Hall Park to the northern terminus, both of the East and West Side lines, will be about 13½ miles.

While the rapid transit system will essentially provide a through express service, it will, of course, run a certain number of local trains. The express trains will make but few stops, and the two inside tracks of the four-track road will be reserved exclusively for their use. There will be express stations at the most important centres only. The local trains will make use of the two outside tracks, and will, of course, stop at every one of the 43 stations between City Hall Park and east and west side terminals. The small number of stops and the considerable distance between stations will enable the express trains to maintain a high average of speed, and will bring the total time of making the trip from City Hall Park to the Harlem within measurable distance of the "15 minutes" which has long been the dream of the New York travelling public.

With the exception of that portion of the road beneath the present Fourth Avenue tunnel of the Metropolitan Street Railway (fig. 1), below Central Park (fig. 4), and where the road passes beneath the Harlem River (fig. 5), and the elevated portions of the lines (fig. 6), the road will be carried in a steel and concrete conduit of absolutely waterproof construction, details of which are shown in fig. 10. The floor of the conduit, or tunnel, consists of a foundation layer of concrete, which will vary in thickness from 8 inches upward according to the conditions of the underlying material, being 8 inches on rock, with an increasing thickness on loose and damp material. Above the 8-inch layer will be spread a layer of waterproof material, which will be put down as follows: After the 8 inches of concrete has been carefully smoothed off, a layer of hot asphalte will be spread upon it. Above this will be laid and rolled down a sheeting of felt. Then another layer of asphalte will be spread, the process being continued until the desired thickness of waterproofing has been put down, the layers of felt varying from two to six according to the moisture and general characteristics of the surrounding material. Above the waterproofing will be placed another layer of concrete, in which will be set the tracks and stone pedestals for the steel columns and I-beams supporting the roof and sides of the tunnel. The steel framework of the tunnel is made up of transverse bents consisting of built-up columns spaced 5 feet apart longitudinally, and 12 feet 6 inches apart laterally. Above each bent will be heavy I-beams, the wall columns consisting also of heavy I-beams. The space between the I-beams of both the wall and roof will be filled in with concrete, which will be smoothed off flush with the outer flanges of the metal work. Immediately upon the flanges and the ontside surface of the concrete filling, as thus finished off, will be placed a complete layer of asphalte and felt waterproofing similar to that used in the floor, and described above. After the felt has been put in place an outer layer of concrete, which will vary in thickness according to the nature of the excavation, will be carefully rammed in place. It will thus be seen that the whole concrete tunnel is enclosed by a waterproof envelope which extends entirely around it.



10.—Cross Section and Longitudinal Section, Showing Steel-and-Concrete Construction.

In fig. 8 is shown the detail of the track construction, which is built into and forms an essential part of the concrete flooring of the tunnel. The 80-lb. steel rail is carried on white oak wooden blocks, which are laid with the grain

transverse to the rail. The rails with their bearing blocks, are held in place by two deep channel-iron guard rails, which are bolted to metal cross ties embedded in the concrete. The inner channel is sufficiently deep to form an effective guard rail to keep the cars in line in case of derailment.

The double-track subway, as shown in fig. 3, is in all essentials similar in construction to the four-track portion, and this drawing will apply equally to the west and east side lines.

As we have already stated, there are several points at which the standard construction of the tunnel, as already described, is replaced by tunnel construction of the ordinary type. The first of these will occur beneath Park Avenue (fig. 1), where the four tracks will be placed in two tunnels below the level of the present Fourth Avenue tunnel. These tunnels will be excavated through the solid rock, and will be lined with concrete or brick with a back filling of masonry or concrete. The next tunnel will occur where the east side line passes beneath Central Park, and as it will lie at a considerable depth below the surface, it will be necessary to instal a system of artificial ventilation, as shown in fig. 4, where a vertical shaft will lead from the tunnel to the surface. In the shaft will be installed a powerful, electrically-driven, ventilating fan. The next departure from standard construction will be at the Harlem River, where the track will be carried in two parallel single-track cast-iron tubes, each of which will be 16 feet in external diameter. As this part of the tunnel will pass through the soft material under the bed of the river, the tubes will be laid in a casing of concrete, as shown in the drawing. The roof of the tunnel will be approximately 21 feet below mean low water on the Harlem River.

Both the east side and the west side branches will contain a considerable amount of elevated structure. On the west side lines the tracks will leave the tunnel construction at One Hundred and Twenty-second Street, and will be carried on a masonry and steel viaduct to near One Hundred and Thirty-fifth Street, over 2,000 feet of this distance consisting of a steel viaduct of the kind shown in figs. 6 and 7. The approaches of the elevated structure will be of masonry, and the steel portion will consist of plate girder spans supported on plate cross girders carried on built-up columns which will be set on the curb lines.

As first constructed, the structure will provide for two tracks, but with wise forethought, the engineers have provided for an enlargement of the floor system by means of a bracket construction (see portion of drawing, fig. 7, shown in dotted lines) which will enable an additional track to be placed on each side of the structure. This arrangement will render it possible in the future to double the capacity on both the east and west side branches when the necessities of traffic call for it.

We show in fig. 3 a view of one of the most important stations on the line, namely, that at the intersection of Fourteenth Street and Fourth Avenue, which may be taken as typical of most of the stations of the system. Access to the station will be had by means of double stairways descending from the edge of the sidewalks, one on each side of Fourteenth Street, east of Fourth Avenue, and one on the south side, west of Fourth Avenue.

At the foot of the first flight of stairs from the street will be the ticket offices, from which the passengers will proceed by elevated crossings to the platforms, which will be four in number, the two outer platforms being for local traffic and the two inner ones for express trains. The interior of the stations will be lined with white enameled brick, and, as they will be brilliantly lighted with electricity, there will be none of the gloominess which is naturally associated with the idea of an underground station.

The cars will be commodious and well lighted, and will, indeed, embody all the latest improvements known to the electric car builder. It is probable that the third-rail system of electrical construction will be used, although, we believe, the details of the electric installation have not been thoroughly determined upon.

The plans for the road were drawn up by the chief engineer of the Rapid Transit Commission, Mr. William Barclay Parsons, and the contract, which has been let for a round sum of $35,000,000, has been undertaken by Mr. John B. McDonald, who expects to have it completed within three years' time.

LEGAL.

Rucker *v.* The London Electric Supply Corporation, Limited.

(*Continued from page* 223.)

Judgment.

In the Chancery Division of the High Courts of Justice on Monday Mr. Justice Farwell gave judgment in the action Rucker *v.* the London Electric Supply Corporation, Limited, the hearing of which had occupied the Court for nearly nine days.

His Lordship said: The plaintiff claims, by assignment, letters patent of March 16th, 1885, for an invention for improvements in distributing electricity communicated by Zipernowsky and Déri, of Buda-Pestb, and by his writ, dated July 1st, 1898, seeks for an injunction and an account of profits or damages against the defendants for breach of his patent. As his patent has expired since the date of the writ, he can, of course, obtain no injunction, but this does not affect his claim for an account or damages for breaches during the existence of the patent. The defences raised are that there is no patentable invention in the plaintiff's specification, prior publication, and want of novelty. The first issue that I have to determine is the state of knowledge of electricians with reference to lighting by electricity at the date of the patent. Since the year 1870 electricity had been applied for lighting purposes, and various advances have, from time to time, been made in the means adopted for that purpose. The first lamp used was the single arc lamp with a dynamo of its own. Then Jablochkoff showed the possibility of sub-dividing the electric light by putting several lamps in series on a circuit and by connecting several circuits to one dynamo. Then the arc lamp was replaced by incandescent lamps, which were run in parallel and required constant potential, a requirement which entailed considerable practical difficulties. The desideratum was to obtain a constant pressure on the lamps and a small amount of copper in the mains; and this involved sending out from the station at high pressure and using the power of the lamps at low pressure. Both continuous and alternating currents were used. I find that the following facts existed in March, 1885:—(1) The parallel system of distribution, giving on each consumer's premises a supply of electric energy at constant potential to be drawn off in multiple arc, both for continuous and alternating currents, was well known. (2) Transforming or induction coils were well known as machines by which the electrician could transform up or down by multiple, or divide the tension on the primary. (3) It was also known that the electromotive forces of the two coils bore a constant ratio to one another, depending upon the number of turns of wire on the primary and on the secondary. The question of the ratio of turns is well put in the article in *La Lumière Electrique*, where M. Marcel Deprez, referring to Gaulard and Gibbs' secondary generators, writes in 1884 as follows:—"In substance these generators are composed of a series of solenoids of little height and large diameter, traversed by an alternating (so called) primary current, taken from any source; this alternating current generates by induction in a second series of solenoids, situated at a very short distance from the first solenoids, and, moreover, intercolated between them, an induced (called secondary) current, the tension of which depends on the proportion of the number of the inducing spires to the number of the induced spires and also on their joining." Moreover, both Mr. Fesquet and Mr. Ferranti told me that they knew this themselves prior to 1885. I have mentioned this because there is some conflict of testimony on this point between the plaintiff's and the defendants' witnesses, and I desire to say that I accept the defendants' witnesses as more accurate in this respect than the plaintiff's. I think that Mr. Swinburne does less than justice to the electrical knowledge of himself and his followers in 1885. (4) The excitation or actuation of an induction coil by a machine for the purpose of utilising the secondary circuit was not novel. (5) Putting machines in parallel on secondaries of an induction coil was not novel. (6) The positive and negative poles in the consumer's house which are connected with the double series of mains required in the parallel system are the equivalent of a dynamo producing a constant tension. In the year 1882 the Electric Lighting Act was passed, and in that and subsequent years many Acts had been passed confirming provisional orders under the Act. The basis of that legislation was, that it was feasible to generate electricity at central stations and supply it to consumers in much the same way as water is supplied. The powers of the supplying body, however, ceased at the two poles in the consumer's house referred to above, and the consumer took his supply by straddling the mains at those two poles, viz, by putting the transformers on the poles in parallel on the secondary circuit, and, as Mr. Swinburne told me, the consumer can himself put on the transformers in parallel on an ordinary parallel system. The customer is at liberty to use the current which he so obtains for any purpose that he thinks fit. I should add that the Acts extend both to continuous and alternating currents, and both to the parallel and the series system. Before considering the various documents referred to in the defendants' particulars, I will consider the construction of the patent. The claim of the patent is as follows:—"In the application of induction coils or transformers for alternating electric currents, the arrangement of several stations of second order as branch circuits of the main line (*i.e.*, connecting up the local centres with the main line in multiple arc), to which main line is supplied an alternating current of a tension as constant as possible substantially as described and shown in the drawing." In my opinion, this is a claim for arrangement, and for arrangement only. It is merely a combination in a particular way of old, well-known methods. The difficulty of construing this patent is

increased by the fact that the patentee amended it some time ago by striking out claims for a means of maintaining an invariable tension at the points where the primary current enters the local centres. On the unamended patent, I should have been of opinion that the words "substantially as described" referred to the means of keeping that tension as constant as possible; but I cannot so read them now that the provisions relating thereto have been struck out. In my opinion, therefore, the words must be read, "the arrangement substantially as described." I have, therefore, to consider if there is anything in the body of the specification affecting that claim in any way. Now, the specification commences by a historical statement, followed by a reference to the inefficient modes of distribution then in use, and states that the object of the invention is to make all individual points of consumption of electrical energy quite independent from one another; and it goes on to state in general terms the mode of doing this, which is in effect what is stated in the claim that I have already read. The inventor then states that "The distinctive feature of our system of distribution is that each group of induction coils, or transformers, of the several stations of second order shall merely constitute branch circuits of the main line for the primary current, *i.e.*, that primary circuits of the several local centres, any one of these being taken as a whole, are connected in multiple arc. In this manner we have conductors distributing the primary high tension current in as many branch circuits as there are local centres, and any desirable number of secondary (low tension) circuits." I pause to observe that there is nothing here as to the form of the transformer to be used, but that the patentee says that the distinctive feature of his invention is the arrangement in parallel arc. It appears to me that he believed himself to have discovered the use of transformers in parallel arc on secondary circuits; and this seems to have been to some extent the view of Mr. Swinburne when, in answering Mr. Moulton's question, "In what respect do defendants infringe?" he replied, "In that you have a system of distribution with alternating current transformers with high tension in primaries of 20,000 volts, and secondaries supplying lamps in parallel at 100 volts," and he said also that he considered the high tension and the low tension of the mains both essential. Pausing here, I am of opinion that no patentable invention is disclosed by part of the patent, if this be the essential feature of it. Mr. Swinburne, a short time before, had admitted that as early as 1882 the advantages of high tension and low tension were well known, and further, that high tension and low tension are mere descriptive epithets, having no technical meaning. I hold, as a matter of construction, that high and low tension are not within the plaintiff's claim, *i.e.*, that the words are merely descriptive, and express nothing beyond the fact that the primaries are of high tension in comparison with the secondaries. The next four lines of the specification, as I have already stated, have given rise to some conflict of testimony. They are as follow:—"Now the electromotive forces of the two coils of the transformer bear a constant ratio to one another; therefore if the internal resistance of such an apparatus is very low, the secondary tension will remain almost unaltered if we only have a constant difference of potential at the terminals of the primary coil." I have already found that the various statements in these lines were, and were intended to be, mere statements of well-known facts, and that this was intended to be so as a matter of construction is made clear to my mind by reference to the unamended specification, which I am entitled to look at for this purpose according to Lord Watson's statement in the House of Lords. It is to my mind plain, on the original specification, that these lines were statements of fact leading up to and emphasising the value of the means for maintaining an invariable tension which formed part of the original specification. Some argument was used on the advantage of keeping the resistance as low as possible, but this seems to me to be a mere truism, amounting simply to a statement that it is desirable to avoid useless waste, because excessive resistance exhausts the energy that is wanted for lighting by turning it into heat. Passing over some paragraphs in the specification, I come to the following statement on the last page:—"We desire it distinctly to be understood that the form of induction apparatus or transformers may be of any kind whatever, without departing from the principle of our invention." That is a claim extending to all transformers of every sort, but transformers were well known, and were in common use before the date of the patent. Lord Kelvin told me that no practical man would have been afraid to put inductors straddling across mains of a high pressure alternating current circuit, and that there was absolutely nothing novel in it. Mr. Swinburne put the plaintiff's case very neatly when he said, "Everybody knew that we wanted a high pressure from the station, and a low pressure in parallel distribution in houses. They—Zipernowsky and Déri—came and they realised that a transformer arranged in a particular way which was not the usual way of arranging them, gave them the key to the solution of the problem." Assume that it was not "the usual way," as he says; it was, however, a well-known way, and I am wholly unable to discover any invention in it. Authorities on different specifications are of little value in questions of construction, but I think the case of Gaulard and Gibbs gives a useful illustration of the application of the principles upon which the Court acts. To my mind this specification contains at the utmost, good advice, and is very far removed from invention. It recommends one of two well-known modes of procedure as most suitable for conducing to a particular result. I should add that all transformers are said to be within the arrangement claimed; but as a fact, all are not suitable. The plaintiff, however, can get no benefit from this, for he certainly does not point out any particular form of transformer as the appropriate one, or give any guidance whatever in this direction. I will now proceed to consider briefly the defendants' particulars of objections. The most important document, to my mind, is the article in the *Zeitschrift für Electrotechnik*. It was proved that this document was sent over to the Patent Office here, and was laid on the table of the public reading room two days prior to the plaintiff's patent, and it is admitted that it is a description of the plaintiff's arrangement. If, then, this document contains sufficient information of the details of the plaintiff's arrangement to enable a practical electrician to put in operation the plaintiff's arrangement, the case would fail, even if (contrary to the opinion that I have already expressed) the plaintiff's arrangement was a patentable invention. In my opinion the article does contain all such information. I have come to this conclusion both as a question of fact, after weighing the evidence of the witnesses, and also as a question of construction, treating myself as far as possible as possessed of the knowledge of the subject, which a competent electrician would have had in 1885. On construction, I am of opinion that the article indicates, with sufficient precision, that there was a parallel distribution, and that the consumer was to take his supply by transforming down from high tension primaries. Lord Kelvin was clear about this, and I do not consider that his testimony was at all shaken by the cross-examination, although he for the moment forgot the statement in the last paragraph but one of the article, namely—"Currents of respectively 6 and 7 amperes at the maximum flowed through the primary conductors." He set this right in re-examination, pointing out that these words clinched it; and, as a matter of construction, I agree with him, and with Mr. Fesquet and Mr. Ferranti; and further, I do not think that Mr. Swinburne really differed, judging from his manner and tone in answering one of the questions addressed to him on this point. It is needless to say that Mr. Swinburne is not only a most competent, but a most straightforward and candid witness. I think that he meant that he agreed with Mr. Moulton, and the construction that he put upon the sentence that I have just read. In view of the opinion that I have expressed, it is not necessary for me to consider the other documents mentioned in the defendants' objections in any great detail. They are important as showing the general state of knowledge prior to the plaintiff's patent, and they confirm me in the view that I have already expressed. The first is Brush. In this specification, the defendants rely on a drawing only, viz., fig. 9. This figure does, in my opinion, show diagrammatically the system of distribution by parallel mains, and of drawing off by transforming and using secondary circuits. As Mr. Swinburne put it, "fig. 9 is the diagrammatic method of representing transformers in parallel on parallel mains, that is, with their primaries on parallel mains." Again, Lord Kelvin said that "Fig. 9 shows diagrammatically with perfect clearness, five transformers placed in parallel on the mains of an alternating current dynamo machine. The diagram alone, with the statement that this applies to transformers in alternating current machines is unmistakable." And as Lord Kelvin said:—"The problem of distribution is represented in fig. 9, although the problem as to the size of dynamos and the method of getting electricity over a large area is not dealt with." But I cannot see that this affects the question when you had once arrived at the fact that parallel distribution was well known before 1885. I agree with Lord Kelvin that given that knowledge, there was no invention in proposing to do at 20 places what was done at one. I will pass by the article in the *Times* referring to Fuller's patent with the remark that I hold to the statement, there is a statement of parallel distribution, but that, if that article stood alone, I should have had some difficulty in thinking it sufficiently explicit. The next document is Edison's patent of 1883. This is very remarkable, because on the evidence before me I find that Mr. Edison has the whole of the plaintiff's arrangement, and something over and above and quite independent of that arrangement, and that Mr. Edison—I say it with hesitation of so eminent an inventor—apparently failed to appreciate the full advantage of his own invention, but to have been led away by his desire to secure continuous current. As Lord Kelvin said, "Edison's arrangement without the commutators is the plaintiff's arrangement," and the only object of the commutators was to convert the continuous current into an alternating current of high tension, which then passed through the transformers and came out as an alternating low tension current to another commutator, the object of which was to deliver a continuous low tension current, but no alteration was effected either in the tension or the quantity. Mr. Swinburne did not really disagree with this view, for he said that if you remove the whole of the commutators and substitute alternating currents you have the Zipernowsky system, and the only objection that he suggested to Edison's system had reference to the commutators, namely, that there would be such serious sparking at the commutators that they would not work. The only other matter to which I need refer is the installation under the Gaulard and Gibbs' system. I accept Mr. Fesquet's testimony with regard to the exhibition at the Aquarium in 1883. I make no sort of reflection, of course, on Mr. Mackenzie, but he had for some years ceased to be employed in electrical engineering, and I am convinced that he had no really accurate recollection on which I could rely. I find that in 1883 Fesquet coupled the primaries in parallel as well as in series many times, and that the lamps were placed in parallel on the secondary wires; and further, that in 1884 there was an installation on the Metropolitan Railway running for some months, in which alternating high tension currents were transformed down, and that the lamps were in parallel. I mention this because I desire to say that in my judgment Mr. Ferranti was a competent and trustworthy witness, on whose evidence reliance can be placed. I think that it is unnecessary for me to refer in detail to the Imray specification, or to Rankin Kennedy's article, the last sentence of which is certainly remarkable. The result is that the plaintiff's action fails, and must be dismissed with costs.

Mr. Cripps (for the defendants) asked for costs on the higher scale.

His Lordship asked if that was done generally.

Mr. Walter (for the plaintiff) said that he could not say that it was usual.

Mr. Cripps said he knew that it was done in such complicated cases as this.

His Lordship: Do you object, Mr. Walter?

Mr. Walter: Yes, I do.

Mr. Cripps said he had known costs on the higher scale being given in cases of less complexity and difficulty.

His Lordship: I see in the White Book something that helps you, Mr. Cripps. It says that costs on the higher scale will be allowed in patent cases where scientific witnesses are necessary to be called.

Mr. Walter submitted that in this case no experimental work had been required. It was only examination and construction of documents. It was a pure question of argument on the construction of documents.

Mr. Cripps said that in this case they had had necessarily on both sides the most eminent men.

His Lordship: Well, Mr. Walter, I should think that probably even you would prefer that I should give costs on the higher scale.

The action was accordingly dismissed, with costs on the higher scale.

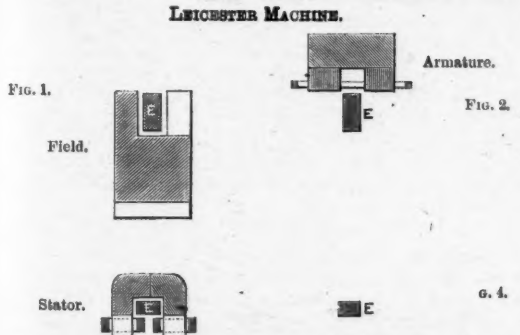
CORRESPONDENCE.

Inductor Alternators.

I trust you will forgive me once more trespassing on your space with regard to this question. The interesting experiment you suggest with the Leicester machines would, I think, prove the strength of my argument. Let us in theory remove the part you call the inductor, and which I call the revolving field, and then calculate the strength of the magnetic flux set up around the exciting coil with a certain strength of current in that coil. Then replace the field, remove the stator, and repeat the calculation with the same current strength in the coil, you will find the flux is now three to four times as great. The reason is self-evident by reference to the figs. 2 and 1. In the first case the flux has an iron path on only one side of the coil, whereas in the second case it has an iron path on three sides.

Returning to Mr. Mordey's original inductor alternator, a tracing of which I sent last week, it is evident that the strong field is produced when the stator is left in position with the coil (fig. 3). This, therefore, is the field of the

Leicester Machine.



Mordey Inductor.

machine, and it answers exactly to its description; the armature coils *are* wound on the polar projections of the field, which is decidedly not the case in the Leicester machine. In fact, the machine is of a widely different type, and if you carried out the experiment you suggested, you would find that you would *not* get any throw in a galvanometer in circuit with the armature coils.

A Mordey inductor alternator under similar conditions would certainly give a very strong deflection. In the Leicester machine the flux entering and leaving the same coil on the same side cancels its own effect. These two machines differing so widely are both included in your definition of an inductor alternator, and prove my statement that the term is simply meaningless if it has become general to give it to all machines with fixed exciting and armature coils.

That it is general practice is to be doubted, as on the Continent, where the type of alternators with fixed coils and revolving fields were first made to practical requirements, and where still they are mostly made, the term is hardly ever used.

Percy Rosling.

The correspondence appearing in your last issues on this subject put me in mind of an article I had seen in the *Electrotechnische Zeitschrift* some years ago. It is the reprint of a very able paper read by Prof. E. Arnold on February 6th, 1895, on "Unipolar Induction and Alternators with Stationary Windings."

After dealing with the theory, the Klimenko machine, also mentioned by Mr. Rosling, is given as the first instance of an alternator of that class, it also appears from that paper that the type now mostly in use has been devised almost simultaneously by Mr. R. Kennedy, in England; J. Sohlmann, in Germany; and Messrs. Kolben & Arnold, in Switzerland; closely followed by the Stanley Electric Manufacturing Company in America.

Prof. Arnold defines this class of machine as "unipolar," and considering his early and useful work in connection with this class of machine, his opinion is well worth recording.

He points out that the main difference between the type then being developed and the ordinary alternator lies in the fact that the magnetic flux in the latter goes through a complete cycle, whereas in the unipolar type that flux only varies its intensity without reversing its direction, thus securing a number of most important advantages.

Prof. Silvanus P. Thompson has recently objected with reason to the use of the term "unipolar," substituting for it the term "homopolar" as opposed to "heteropolar."

Adopting these terms we can divide alternators into two great classes. The "Homopolar" and the "Heteropolar."

Both these classes allow of a construction which secures stationary windings throughout the machine.

The definition of an inductor alternator as given by Mr. Rosling is quite correct, it defines a type of machine which is to be found in both these classes, the Kingdon machine being an illustration of the heteropolar inductor, the Mordey machine referred to by Mr. Rosling, and which has never been tried in practice to my knowledge, illustrating the homopolar inductor.

The Leicester type of machine is absolutely unique, since the action of the poles on the laminations classes it as homopolar, whereas the polar action on the conductors entitles it to be called heteropolar, under no circumstances can that type be termed an inductor alternator.

The polar action on the iron being of the greater importance (since whether the conductors are subject to discontinuous homopolar or to heteropolar induction, the result is the same, viz., alternating current), I should say the Leicester machines were "homopolar alternators," and if greater precision was required would add of the "revolving field type."

Val. A. Fynn.

The Use of Rubber-Insulated Wires in Steel Conduits.

Taking your correspondents' letters in the reverse order of their coming, I must thank Mr. Isherwood for so clearly showing that I did not consider 300-megohm insulation good enough. The 600-megohm class I advocated has, I believe, for small wires, an actual insulation of 2,000 megohms.

Mr. Heaton also does me the honour to compare my recent statements with some made in 1897, but we must all advance with the times, and since Simplex tubes have come on the market, it would be absurd to use ordinary gas pipe. I should again like to point out that the moral of my article was intended to be that only the highest grade of wire should be used in any system of conduit, unless some insulating material, less perishable than vulcanised rubber, can be found. It is, of course, possible to criticise indefinitely, but I think that in this matter we ought to pull together.

In this respect I thank Mr. Bathurst, who has allowed himself to be drawn. I have always thought that he had something up his sleeve in the way of bare inner and earthed outer, and, although this opens quite a new and very large question, I hope, when he has succeeded in sweeping away some of the prejudices of the supply authorities to earthed outer systems, he will take us into his confidence and show us that there is "no deception." With regard to bare

inner wire—this question was touched upon in an article in this journal last year on insulating conduit, and it was therein pointed out that it would be necessary to run one tube for every bare wire—*i.e.*, that two bare wires for different circuits could not go in one tube, but in his subsequent letter Mr. Bathurst did not reply to this point.

I cannot myself see, if Mr. Bathurst is going to put a bare wire in an insulated tube, why he should not at once use a concentric steel armoured wire. What is the use of the air-space in his tube? Perhaps he will say, or must we wait for the electric wiring millennium?

V. Zingler.

Paralleling Single-Phase Alternators.

I have read with interest your correspondent's suggestion, or method, for detecting whether the incoming engine is going too fast or too slow when paralleling single-phase alternators. It appears to me, however, that the well-known "spot" method is much more simple and applicable to those who "parallel" as part of their daily routine.

In the case of fly-wheel alternators these spots are simply a series of black and white patches painted on the rim of the fly-wheel, and, with disc armatures, generally white patches only are painted on the armature disc in the form of a circle. By the light from an alternating arc lamp these spots clearly show in which direction the incoming engine is running. If too fast, the spots appear to move in a forward direction, and if too slow the reverse. This method is used in many central stations, and drivers readily know by watching the "spots" whether the engine is running above or below synchronising speed. It is also a very useful guide where the alternators are placed at a distance from the switchboard, and in many cases out of sight of the operator. In the case of the Mordey alternator this phenomenon can be easily noticed by glancing at the field pole-pieces, the poles of the magnet acting as spots.

Ernest W. Dunton.

February 10th, 1900.

Departure of Electrical Engineer Volunteers for Service in South Africa.

You will probably have seen a letter from Mr. McMillan, honorary secretary to the Dinner Committee, who are arranging for a good "send-off" for the Electrical Engineers (R.E.) Volunteers leaving for South Africa. I would like to take this opportunity of saying that already a good response has been made to this appeal; and that many gentlemen from different parts of the country are sending their cheques, though frequently stating that they will not be able to be present at the dinner. Thinking that this may form a precedent with regard to other of your readers, I would intimate, by your courtesy, that we should like a good response from the entertainers of our friends who are going abroad, and shall be glad to receive cheques from those who also will not be able to attend the dinner.

Henry Edmunds, *Honorary Treasurer.*

Hoepfner's Carbon.

In one of the articles recently published on the electro-chemical industries, I observe that the anodes employed in some works are described as "Hoepfner's ferro-silicon and graphitoidal carbon obtained by methods of Castner and others."

I would be pleased if you can inform me who are the makers of this carbon, and where it can be obtained.

G. W.

Swansea, *February 9th*, 1900.

Deficient Postage.

I have several times recently received typewritten circulars from patent agencies in New York with only a portion of the postage paid, with the result that I have had to pay something like 5d. in each case for absolutely valueless communications. The two chief offenders are the International Patent Exchange Bureau, of 305, Broadway, New York City, and Edgar Tate & Co., 245, Broadway.

I shall be obliged if you will give publicity to this letter, as I think the meanness of the trick is deserving a public protest.

The envelopes are invariably sealed up, and it is quite impossible to say whether the letters contain anything of value or not, until opened.

Walter P. Adams.

February 12th, 1900.

Friction Losses in Dynamos.

I find some difficulty in reconciling the apparently contradictory statements in Mr. C. C. Hawkins's letter on the above subject. According to Mr. Hawkins, the bearing friction increases when the machine is excited—if there is a want of symmetry in the field—because the shaft is bent by the magnetic pull exerted on it by the field, so that the relative positions of journal and bearing are altered. This, no doubt, is perfectly true, and, *if the shaft is appreciably bent*, then the statements made in my article are not correct. So far everything is plain. But Mr. Hawkins next goes on to say that if there is increased heating, it may be due to *bad design, owing to which the shaft is not sufficiently stiff.* Evidently, then, Mr. Hawkins holds, and in this view he will, no doubt, receive the support of all competent dynamo designers—that the shaft should be given sufficiently liberal proportions to enable it to withstand any additional pull due to want of symmetry in the field, *without appreciable bending.* If, however, there is no bending—*i.e.*, if we are dealing with a mechanically well-designed machine—then any slight want of symmetry in the field will not, as Mr. Hawkins admits, cause increased friction loss. It therefore appears to me that Mr. Hawkins himself refutes the statements contained in the opening sentences of his letter, and that he practically admits the soundness of the views contained in my article—so long as these are not applied to machines of poor or antiquated design.

Alfred Hay.

University College, Liverpool,
February 9th, 1900.

Mechanical Stokers.

I have noticed in this week's issue of your paper a review of my contribution to the *Engineering Times* on "Mechanical Stokers."

Personally, I thought it was only too well known among engineers, and also among many steam users, that the coking stoker does very poor work in boiler efficiency; I have come across many instances of 7-foot Lancashire boilers and coking stokers, where an evaporation of 400 gallons per hour, and sometimes less, is being obtained with bituminous slack as fuel.

I think your readers will agree that 400 gallons per hour is just about poor enough for a boiler of the size named; with the combination of forced draught and coking stoker, it is quite possible to get 800 gallons an hour out of the same size boiler, and at the same time the highest efficiency in fuel duty. I may say that with this combination I have seen 1,262 gallons per hour evaporated from a cold feed with nuts as fuel and an 8-foot boiler (this without smoke, CO_2 13 per cent.).

There is one thing in your review I must take exception to; you apparently agree with me that steam jets which have been so generally adopted for keeping bars cool, are very wasteful and of little use; then, because I recommend a forced draught stoker with steam jet blowers, you proceed to say that I have recommended what I have condemned. I would point out that I do nothing of the kind; steam jets with the ordinary stoker are not used in connection with a blower, and a large number of them are used, while they serve no useful purpose, whereas with the forced draught stoker only four are used in connection with the blowers, their main object being to give a proper air supply, and to do good boiler and fuel duty, and in doing that, of course, the bars are kept cool by the action of the air in the enclosed ashpit; these jets use at the most 3 per cent. of the total evaporation, and enable the coking stoker to perform such work as has never been approached before, while ordinary steam jets have been proved to use 8 per cent. of the total evaporation, and for the most part utterly failing to do any good.

W. Francis Goodrich.

An Electrolytic Centrifugal Process for the Production of Copper Tubes.

Some years ago I availed myself of the hospitality of the pages of the Electrical Review to make a reclamation of my discovery of the synchronous rotation (parallel running) of alternating dynamo-electric machines. I have now to request that you will be good enough to publish in your next issue the subjoined reclamation of the electrolytic centrifugal process described in the Review of the 9th inst. The reclamation is a copy of my contribution to the discussion on Mr. Cowper-Coles' paper read before the last meeting of the Institution of Electrical Engineers.

Henry Wilde.

Alderley Edge, *February 12th*, 1900.

Mr. H. Wilde, F.R.S.: I have read with much interest the paper of Mr. Cowper-Coles on an electrolytic centrifugal process of producing copper tubes. May I point out that the process described is identical with the one patented by me in 1875, No. 4,515, which has been in successful operation in Manchester and elsewhere for more than 20 years? By the publication of his paper, Mr. Cowper-Coles has, however, rendered an important service to the electro-metallurgical industry in exposing the fallacy of submitting electro-deposited surfaces to the friction of foreign substances during the process of deposition. His paper also contains much valuable information on the electro-metallurgy of copper which is not available in other publications.

Subjoined are extracts from the specification and claims of the patent referred to:—

"Whereas attempts have been made from time to time to substitute iron rollers covered with a thin layer of copper by means of electricity, for the solid copper rollers used in calico printing and in other processes, but owing to the expense of the battery power, and the slow rate at which the copper was deposited in the reguline state, such attempts have not hitherto been commercially successful.

"Now my invention consists in giving to the electrolyte or depositing liquid in which the roller to be coated is immersed, or to the positive and negative electrodes themselves, a rapid motion of rotation in order that fresh particles of the electrolyte may be brought successively in contact with the metallic surfaces. By this means powerful currents of electricity may be brought to bear upon small surfaces of metal without detriment to the quality of the copper deposited, while the rate of the deposit is greatly accelerated. (p. 4).

"Instead of producing the whirling motion of the electrolyte by the rotation of the roller, B, as above described, it may be produced by the rotation of the positive electrodes, G, mounted on a revolving frame, or by paddles revolving in the annular space between fixed electrodes and a fixed roller. (p. 5).

"This invention may also be applied to the electrolytic method of refining copper described in the specification of letters patent granted to J. B. Elkington, November, 1865, No. 2,838. (p. 4).

Claims:—"First, imparting a rapid whirling or rotating motion to a depositing solution in the manner and for the purpose described.

. . . . "Lastly, the application of the whirling or rotatory motion of the electrolyte in the refining of copper and the apparatus for effecting the same, as shown and described."

[Reply to "A Weekly Subscriber," whose letter appeared last week.—Messrs. Ward & Goldstone, York Street Electric Works, C.-on-M., Manchester, write that they can supply and cover the wire required.—Eds. Elec. Rev.]

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting held on Thursday evening, the 8th inst., the President, Prof. S. P. Thompson, announced that the executors of the will of the late Prof. D. E. Hughes had communicated to him the fact that the will contained a provision for a legacy of £2,000 to the Institution, to be invested, and to form the "D. E. Hughes Scholarship Fund." This fund is to be administered on similar lines to the Sir David Salomon's Fund, and is to be used for provision of scholarships to assist students preparing for the calling of an electrical engineer. The Secretary announced that Mr. A. W. Heaviside had been appointed chairman and Mr. W. D. Hunter vice-chairman of the Newcastle Section of the Institution.

Mr. R. Percy Sellon then read his paper on "The Standardisation of Electrical Engineering Plant." In the discussion Mr. Crompton, after thanking Mr. Sellon for bringing the subject before the members, said it was a paper of arguments with which he thoroughly agreed, and all should help the writer to carry out the suggestions at the end of the paper and strengthen the Uniformity Committee of the Council. Manufacturers in England had suffered from the vagaries of consulting engineers, but he did not think that very much harm had been done up to the present. The list of stations at the end of the paper, no doubt, did show variations, but that list showed that consulting engineers had not insisted upon great variations. The 100-volt pressure of supply had been in cases raised to 110 volts to enable two arc lamps to be run in series: after several years it was discovered that manufacturers could make higher voltage lamps, and when the lamp makers had so far improved their manufactures that it was possible to use double-voltage lamps the higher pressures came into general use. Mr. Crompton thought the list proved that consulting engineers have not behaved badly. On the question of periodicity, he thought Mr. Mordey could deal with that point better than he could. No doubt a greater variety of frequencies than of pressures has pressed very hard upon manufacturers, and only makers of motors and arc lamps know the anxiety of having to meet the requirements of so many different frequencies. All must agree that the advantages of standardisation would, in the end, come to the user as much as the producer. Take the ordinary conditions of life, sewing machines, for example, are turning out in large quantities exactly alike. Only when motors are produced in very large quantities can they be produced at a price the user cares to pay. The trade in $\frac{1}{3}$ H.P. and $\frac{1}{8}$ H.P. motors—such sizes as are used in houses for small domestic purposes—has been stirred up, and there has been a very great lowering of cost. Also the working of tools taking a definite amount of power with motors fitted on these tools is another outlet demanding cheap motors. He thought it was evident that by a natural law beginning at the smallest motors, we shall gradually standardise them, but there was no doubt the Institution could assist by calling the attention of the engineer of the user to the enormous advantage of adopting the principle of standardisation.

Mr. Blackburn believed that each manufacturer must begin at home and then try to convince the user of the benefit. If each manufacturer did that agreement would gradually come. If the user would state the ends, the manufacturer would find the means. He thought that in dynamos and continuous current apparatus and machinery, there was a tendency to gradually arrive at a basis. It would lighten the task of the manufacturer as regards continuous current dynamos if the engine builder would help to reduce the very considerable present diversity of speeds; the assistance would be very great if makers of engines would arrive at a definite standard of speed. As regards competition, he thought that the case usually cited showed that the principle of standardisation had arisen from the quantity required and not quantity from standardisation.

Mr. Slater Lewis thought the first question was how to meet this point of competition; that this country is being beaten is a matter beyond doubt. He had worked out the effect of one manufacturer making machines of one size and type only; the plant and establishment charges would then fall enormously, and cranes and tools could be better proportioned to the work required of them. With one style and size only of dynamo, he reckoned the establishment charges would fall 60 per cent.; in electrical manufacture these charges are generally much higher than with anything else. Large shops are filled with all sorts and sizes, from machines the size of a hat to those 15 or 16 feet in diameter. We must standardise. He thought Mr. Crompton was wrong when he said that these things will right themselves automatically. He had arranged with his own firm to standardise a series of motors, and he hoped in a short time to sell nothing else, but manufacturers must be supported by by consulting engineers. Various specifications required work involving alterations in patterns and of drawings. In almost every dynamo manufacturer's shop in this country the stores were huge. He would be only too pleased to see some steps taken to standardise as the most effectual way of meeting foreign competition.

Mr. Johnson said he had something to do with assisting to standardise electrical apparatus. The first thing was to standardise what you want, and let the manufacturer

standardise that. In the States a traction company simply says it wants so many cars, motors, &c., and gets them out of manufacturers' stock, so to speak.

Mr. Raworth was glad to note the very hearty reception of the paper by a very large audience. He was sorry the author had not read the paper before at the Institution, but Mr. Sellon had given them a very good paper that evening, and had thrown down upon the floor something he likened to a bone long enough for two dogs to get at at the same time. When Mr. Mordey read a paper he had spelt dynamos the wrong way, and had more nearly immortalised himself by that than by his many inventions. Mr. Sellon had given his paper a wrong title that did not fit it. Here Mr. Raworth asked the meeting to consider the meaning of the word plant, as the word is used in legal documents: "The machinery, tools, and utensils used in a particular trade." A charwoman buying buckets and scrubbing brushes bought plant; when a lady did so, she only bought domestic utensils. Mr. Raworth being in his best form, was hugely appreciated, particularly when he went on to a further illustration. A lady keeping a very large girls' school might be asked what she produced, and might reply: "Young ladies most accomplished and elegant." If asked: "Haven't you any wives?" she might find it difficult to answer, as such are produced from her finished article by a "legal process, under the guidance of a parson."—The young ladies, of course, do not become "plant" until *after* the above process!

(*To be continued.*)

BUSINESS NOTICES, &c.

The G.E.C. Staff Dinner.—The tenth annual meeting of the principals, staff, and friends of the General Electric Company was held on Saturday evening last at the Trocadero Restaurant, and notwithstanding a violent snowstorm and the terrible state of the streets a goodly company of some 250 sat down to enjoy the lavish hospitality provided for their delectation. As in 1899, the one regret in an otherwise merry evening was the unavoidable absence of Mr. Gustav Byng, who is still unfortunately unable to face an English winter of the kind we are now passing through. The dinner was one which reflected every credit on Messrs. Lyons & Co., and the quiet and prompt manner in which the serving was performed left nothing to be desired. Later in the evening a smoking concert, the programme arranged by Mr. "Electrophone" Booth, took place, as at former gatherings, but it is a question whether in future it would not be better that a part of the programme at least should be carried out between speeches, which on the present occasion were numerous and lengthy, although everybody deprecated the idea of taking up time. The monotony of speech succeeding speech would be thus avoided by pleasant interludes, and those to whose task it falls to make replies would have a few minutes in which to collect their thoughts. With the dinner commencing but little after 6.30, it was well past 10 o'clock before the concert commenced, and then the items were hurried through with a total disregard of the sequence of items on the programme. But with everybody thoroughly happy and content criticism is out of place, and we merely throw out the above suggestion for what it is worth. Mr. Hirst made an admirable chairman, and he was ably supported by Mr. Max Byng, and Mr. Eckstein. Mr. Roger Wallace, Q.C., Mr. Raworth, Mr. Dane Sinclair, Major Crompton, and others, were eloquent whether in their serious moments or in lighter mood as occasion required. We regret, however, that exigencies of space will only allow us to refer to the masterly address of Mr. Hirst, which was fitted more for a technical audience than for a mixed gathering of both sexes, but possibly the occasion was seized of having the staff present to read, learn, and inwardly digest food for the mind after repletion of the body.

"Mr. Max Byng, on the occasion of our tenth annual dinner," said the Chairman, "dwelt in the most pleasant manner on our growth and the sterling qualities of our staff. The drift of his statistics was to show how, from a small private firm, struggling for the bare means of existence, we slowly but surely developed into one of the leading electrical firms of the kingdom. I think it should be of interest to know how the G.E.C., in its process of evolution, has come across difficulties that, to my mind, sooner or later, will have to be remedied if the prosperity of a few modern engineering concerns is to be converted into a supremacy of British electrical industry. In the working out of our scheme of expansion, we came across a number of obstacles which I will reiterate not in the sequence of their relative importance, but in the order in which they happened. Firstly, we had to look out for land. In the selection of our land for the erection of new factories, you will not be surprised to learn that, though we scoured the whole country, there were only a limited number of sites that combined all the strategical advantages required by us, and that some of the most likely sites we selected were unsuitable for some peculiar reason. We met with all sorts of peculiar rights that were attached to different places. Nobody was anxious to exercise these rights, but it was a question of precedent, and, therefore, it became law. Would it not be wiser to have laws adapted to modern requirements rather than laws composed of accidental precedent? Many a community and many an industry would derive benefit from such laws. Secondly, one of the essential points of our site is, that it adjoins a railway line. I was assured it was a considerable concession on the part of one of the leading lines to give us a railway siding, for which we pay, though, from an engineering point of view, there appeared next to no difficulties. How differently do they manage this in countries with which we are asked to compete? The State railways, as well as the private railways, are only too eager to give sidings to manufacturers. They even sell land cheaply to them for the purpose of getting them to open up along their line. We nominally work under the advantage of competition between railways, but we all know that this advantage is really non-existent on account of the combination between railways by which they secure all the advantages of a monopoly without the obligations incumbent on a monopoly in the higher interests of the State. Now that we are no longer the only nation that does business in trans-Atlantic countries, and now that competition with other countries is getting keener every day, it becomes essential that we should offer our foreign customers goods measured and priced easily to understand, or it will be one more point against England in the commerce of the world. The next important question brings me to that of labour. I need only say that I have the impression, though there has been a great deal of labour legislation during the last 20 years, but all that has been done has been mainly in the spirit of how far to give way to the demands of the workmen. The workmen themselves made their demands by simply voting for what their leaders suggested. Now, in my intercourse with work-people, I found there are lots of them who honestly believe what a certain class of labour leaders preach, but they would equally believe the employer if he were to put his side of the question before them in a similar lucid manner. I am convinced, whilst naturally each workman is anxious to increase his wages, many a trouble or strike might have been averted, had the workmen had the chance of hearing the other side, and of getting familiar with the larger issues at stake. I do not therefore blame the workman. I blame the employer for not sufficiently disseminating suitable knowledge amongst the men, and for not being in sufficient touch with the men. Of course I do not say that we employers should start a lot of stump orators in opposition to the present recognised leaders. It behoves us to go to the bottom, and at the bottom of it is *better education for the workman*. Take the sons of a Salford or East London workman, who has his five senses about him, otherwise health, and no particular disqualification; do you mean to say that if he could get his schooling in a class where, besides the people out of his own street (which is generally a slum), he could also meet the cleaner, better dressed and better mannered children of the middle classes, hear something of their amusements and of their homes, do you not think it would open a new world to many, and stimulate their ambition and bring many to a level which, under the present conditions, they could never reach? I am sure such schools would have the effect of producing just the class of people that we most miss in our offices and in our works—the sergeants and corporals of civil life—the class between those at the very top and the "rank and file." The absence of such schools, the absence of some organisation at one time of our life in this country, where for a time everybody is put on scratch, and where merit alone brings him forward, is most detrimental to the production of this important business element. It prevents us leaders getting to know the train of thoughts and the actual wants of our men. It does not give the men the chance to get familiar with, and understand, our aims and aspirations. The question of our wealthy banks not supporting industry in an adequate manner, such as is done abroad, is another serious drawback, but seeing that the Electrical Review has recently raised this point, I dismiss it without further illustration. At a period when the country gives up agriculture as a bad job, when industry and commerce form practically the only means of livelihood, when every branch of industry is ready to remodel itself on modern lines, which means practically on the basis of the electric current in some shape or other, then I think it will not be out of place for me to bring to the notice of our guests the breakers ahead, which the point of vantage of my position allows me to see. It is you engineers, the electrical press, and others of our guests here to-night, who will be asked to guide the governments, the municipalities, and the capitalists of the country; it is you who will have to study some of these serious and difficult problems in order to remove the heavy handicap under which we have to labour, or, anyhow, to point them out to those who have the power to remove them. In the hope that you may be successful in this endeavour, and trusting that we in the G.E.C. may live to reap the benefits, I ask you, my colleagues and friends of the G.E.C., to drink the health of our guests, coupling with the toast the names of Mr. Roger Wallace, Q.C., and Mr. Raworth."

During the proceedings the following letter from Mr. Gustav Byng to the gentlemen of the staff was read:—"You who have worked with me for so many months will understand my feelings to-day—absent from your dinner, far away from London—absent from the General Electric for so many months. However, two factors have somewhat lightened the sacrifice which I have to make to my health. The first is, the doctors give me hopes that I shall regain my health and be able to resume my life's work; the second is this—the management, the ordinary development of the General Electric Company, has not suffered during my absence, thanks to the work and the devotion of my brother, Mr. Hirst, and the whole staff. The main purport of my message to you is to refer to this fact. I wish to point out to you that not only has the General Electric Company not suffered, but has, during the last year, advanced even at a greater rate than during any previous period—that, in spite of my illness, your directors have made preparations for such progress, increase, and enlargement which leads me to hope that, with God's help, the General Electric Company will be one of the foremost electrical enterprises in the world. To belong to the staff of a progressing firm

must be an encouragement to you, and must give you chances for increasing your own material interest, and therefore I am not wholly selfish when I ask you to continue working with heart and soul for the interests of the General Electric Company. At present our country is going through a crisis. It will emerge triumphantly if *every* citizen, rich and poor, high and low, will help. You ask me how? Let every citizen do his daily work with double zeal; he has to work to-day not only for himself, but also for his country. On this ground also, gentlemen, *work* with double energy, and in helping to make the General Electric Company a firm that can and will uphold English manufacture, you will assist not only yourselves, your directors, but also your country."

A telegram was then despatched to Mr. Byng wishing him a speedy return in good health.

Quite a number of prominent visitors were present, and many friends of the firm from the electrical press, consulting engineers, electrical contractors, railway officials, &c.

The G.E.C. is certainly to be congratulated on the high position it has secured, and signs were not wanting that it will not be satisfied until it has found fresh worlds to conquer.

London County Council.—The Parliamentary Committee reminded the Council at the meeting on Tuesday last week that the promoters of the South-Eastern Metropolitan Tramways Bill own some three miles of tramway lines situated between Greenwich Road and Rushey Green, constructed under their Act of 1888, and purchasable in 1909 by the Council under the Tramways Act, 1870. In the Bill power is sought to make certain extensions in Lewisham and Penge, and also outside the County of London. It is further proposed to widen Bromley Road, Stanstead Road, Perry Hill, and Sydenham Road, and certain roads outside the county, and also to take lands in Lewisham compulsorily for an electric power generating station, and to apply to the existing and proposed lines any form of traction other than animal power. Under the standing orders of Parliament it is necessary for the promoters to obtain the consent of the Council, as the "local authority," to the introduction of the Bill. On the recommendation of the committee the Council decided not to give consent to the introduction of the Bill. It was resolved to approve plans for a wood and iron smith's shop to be erected by the Charing Cross and Strand Electricity Supply Corporation in Commercial Road, Lambeth.

Bankruptcy Proceedings.—Under the failure of J. H. Douglas-Willan, 16, St. Helen's Place, E.C., a sitting of the London Bankruptcy Court was held last week before Mr. Registrar Hope, for the debtor's public examination. He states that he came to this country from the United States in 1890, and has since been chiefly interested in two electric lamps known as the Stem and the Bowen. The Stem patents had been allowed to lapse, but the Bowen patents are stated to be worth £500,000, and as the debtor claims one-fifth interest in the patents, he returns that as an asset of £100,000, whilst the liabilities are roughly estimated at £12,000. The failure is attributed to expenses incurred in unsuccessful endeavours to sell the Bowen lamp; to excess of expenses over income; and to the debtor's liability on surety of moneys lent by friends to the Douglas-Willan Satory Company. The examination was adjourned to give the debtor an opportunity of filing the statement of his affairs.

Notice is given in the *London Gazette* of a first and final dividend of 5d. in the £, in *re* A. G. Inrig (Globe Electrical Company), White Post Lane, Victoria Park.

Notice is filed of application for debtor's discharge in the case of E. L. Joseph, electrical engineer, Brondesbury and Canonbury. The hearing is arranged for March 1st at Bankruptcy Buildings.

At Bristol, last week, Frederick King, Stone Bridge, Bristol, electrical engineer, was briefly examined by the Official Receiver, and also by Mr. H. O. Trapnell. He stated that the whole of the furniture belonged to his wife, who bought it when they lived at Leicester before coming to Bristol. He was an improver at the time and had no means of his own. He came to Bristol in 1877 and his wife lent him money to start him in business and made further advances from time to time. The examination was adjourned to March 9th.

Electricity in Country Houses.—One of the the most charming brochures that we have received for some time past is issued by Messrs. Ernest Scott & Mountain, relating to "Electricity in Country Houses." The subject provides ample scope for some beautiful illustration work, and the compilers have made excellent use of the opportunity of producing photographs of some of the electric light installations which they have put into leading country mansions in the northern counties. The illustrator's art is seen on every page, and in the opening pages where are some general notes regarding electric heating and lighting, the accompanying pictures of apparatus are so well executed as to give them a more than ordinary interest. The booklet is a work of art throughout, and the good printing and glazed paper have materially aided in producing a very pleasing effect. From cover to cover there is something interesting, and the capital photographs, both of exterior and interior parts of country mansions, with their palatial halls and their cosy nooks and corners, tell among other things, of the great importance artistic design plays in electric lighting work, where fittings, shades, and so forth have to be brought into harmony with the thousand-and-one other things of artistic taste and beauty to be found within the residences of our town and country magnates. We have said sufficient to show our appreciation of this little publication without labouring with detail, and we understand that Messrs. Scott and Mountain will be pleased to forward a copy to anyone interested in the subject, and, of course, particularly those who may contemplate taking steps in the direction of private house lighting.

Electrical Wares Exported.

Week ending Feb. 7th, 1899.		Week ending Feb. 6th, 1900.	
Adelaide	Value £129	Alexandria. Teleph. wire	Value £25
Alexandria. Teleph. mat	12	Amsterdam	210
Amsterdam	205	Bangkok	141
Auckland	91	Batoum. Teleg. mat.	40
Bombay	74	Boca. Teleg. mat.	176
Boulogne	98	Bombay	83
Buenos Ayres. Elec. light'g app.	1,638	" Teleg. wire	200
" Teleg. mat.	120	Brisbane	90
Calcutta	2,990	" Teleph. apparatus	79
Cape Town	849	Buenos Ayres	2,544
Delagoa Bay	185	" Teleg. mat.	586
Demerara	21	" Teleg. wire	416
Durban	65	Calcutta	1,282
East London	23	Cape Town	244
Ghent	90	" Teleg. mat.	741
Hamburg. Teleg. mat.	300	" Teleg. sundries	95
Launceston	33	Chinde. Teleg. mat.	368
Lisbon	50	Christiania. Teleg. wire	137
Madras	473	Colombo	1,022
Melbourne	79	Copenhagen. Teleg. wire	186
Napier, N.Z.	30	Durban	201
Port Elizabeth	656	East London	48
" Said	20	Flushing	84
Rangoon	50	Gothenburg	37
Rotterdam. Teleg. cable	87	Halifax. Teleg. cable	503
Shanghai	134	Hamburg	571
" Teleg. cable	1,880	" Teleg. mat.	250
" Teleph. mat.	25	Hong Kong	156
Singapore	15	Malta	140
" Teleg. cable	10,500	Melbourne	351
Sydney	1,225	Nagasaki. Teleg. cable	11,800
" Electric light cable	186	Ostend	105
Syra. Teleg. mat.	17	St. Petersburg. Teleg. wire	220
Wellington (N.Z.)	299	Santos	80
" " Teleph. mat.	1,714	Shanghai	101
		Singapore	108
		Sydney	655
		Wellington	210
		" Teleph. mat.	199
Total	£24,374	Total	£24,484

Foreign Goods Transhipped.

Brisbane. Teleph. apparatus	£160
Buenos Ayres. Electric light fittings	120
	£280

Electrical Wares Exported.

Week ending Feb. 14th, 1899.		Week ending Feb. 13th, 1900.	
Adelaide	Value £575	Amsterdam	Value £60
Alexandria	46	Auckland	40
" Teleph. stores	116	Bangkok	27
Amsterdam	340	Brisbane. Teleg. mat.	119
Antwerp	490	Buenos Ayres	26
Auckland	143	" Teleg. mat.	42
Boulogne	82	Calcutta	2,556
Brisbane	23	Cape Town	1,377
Buenos Ayres. Teleg. mat.	683	" Teleg. mat.	899
" Teleph. mat.	39	Christiania	10
Calcutta	308	Colombo	351
Canterbury	200	Durban	128
Cape Town	72	" Teleg. mat.	319
Christiania	22	" Teleph. mat.	80
Colombo	76	East London	191
Copenhagen	297	Hamburg. Teleg. mat.	800
Durban	602	Hobart	25
East London	78	Kobe. Teleg. cable.	71
Hamburg	140	Launceston	63
Hong Kong. 15 tons old teleg. wire (value not specified)		Leghorn	12
Perth	2,734	Lisbon. 2 tons teleg. wire	
Port Elizabeth	345	Madeira	28
Rio de Janeiro	65	Madras	101
" Teleg. mat.	867	Melbourne	260
Rockhampton	39	Ostend	101
Rotterdam. Teleg. mat.	12	Otago	184
Shanghai	14	Perth	182
Singapore	312	Port Said	43
Stockholm. Teleg. mat.	110	Rockhampton	54
Sydney	1,133	" Elecl. mchnry.	1,800
" Teleg. mat.	85	" Teleg. poles	1,195
Toronto	8	Rotterdam. Teleg. mat.	60
Wellington	88	Rouen	74
Yokohama	765	St. Petersburg. Teleg. paper	377
		Shanghai	405
		Sydney	516
		Tientsin. Teleg. mat.	90
		Townsville	50
		Wellington	31
		Yokohama	896
		" Teleg. paper	320
Total	£10,980	Total	£13,363

Foreign Goods Transhipped.

Jersey and Guernsey. Teleg. poles	£75	Gothenburg. Teleg. apprs.	Value £50
		Launceston. Elec. light wares	14
		Malaga. Elec. light wares	16
		New York. Elec. lighting appts.	224
		Total	£304

Electric Power and Cold Storage.—We have received the following letter on the above subject:—"We notice in your issue of the 9th inst. under the heading 'Electric Power and Cold Storage,' a letter from Messrs. Handley & Shanks, of Dublin, commenting upon your note in the previous issue of your valuable paper upon the cold storage installation at present put down for the Birmingham Cold Storage, Limited. We would point out that your note, as far as we are aware, was absolutely correct, and that had your correspondents read it carefully, they would not have written in the tone they have. The Birmingham installation is in no sense an ice-making factory, as they assume, and is, as mentioned, for the cold storage of hops. The total H.P. at present installed is 82½, and space is provided for doubling the plant should it be required at a future date; if we subtract the power installed for ice-making plant

F

elevators, agitators, and gantry, none of which are required in hop cold storage (an existing hydraulic lift being utilised), we maintain that this installation is not only the largest electrically-driven cold store in the country, but the largest in the United Kingdom.—Yours faithfully, HARRAP, HEWETT & DUFFIELD."

"P.S.—The total cubic capacity cooled is three-hundred-and-sixty thousand (360,000) cubic feet."

American Electrical Apparatus.—The *Surveyor* quotes from a letter written by Mr. R. W. Blackwell to a New York exchange, in which he says that the American export business is badly handicapped by the careless manner of filling orders and still more careless methods of packing for shipment. He says that while the field in England is unlimited for American manufactured goods, to occupy it Americans must learn something of the rigid inspection to be passed and of the foreign methods of shipment. He referred to a recent rejection of 300 tons of 4-inch pipe, because two-thirds of the pipe delivered was 3⅝ inches and the rest 3 inches to 3½ inches; 3,000 trolley poles were likewise thrown out because of bad casting, and 40 trolley cars were rejected on account of bad workmanship, and 10,000 feet of American trolley wire would not stand the tension test.

Auction Sale.—On 22nd inst. Messrs. Percy Huddleston and Co. will offer for sale by public auction, at Manchester, a quantity of electrical plant, particulars of which are given among our advertisements this week.

Books Received.—"The Management of Dynamos," by G. W. Lummis-Paterson. London: Crosby Lockwood & Son. 4s. 6d.

"Willing's Press Guide," 1900. London: James Willing, jun. Limited. 1s.

"Problèmes sur l'Electricité," par Robert Weber. Third edition. Paris: Ch. Béranger, editeur.

"Nautisch-Technisches Worterbuch der Marine." Pola; Herausgeber; Redaction der "Mittheilungen aus dem Gebiete des Seewesens." 24 marks.

"The Engineer's Year-Book of Engineering Formulæ, Rules, Tables, Data and Memoranda," by H. R. Kempe. London: Crosby Lockwood & Son. 8s.

Dissolutions, Liquidations, &c.—Messrs. F. Monkhouse and T. Gradon, jun., electrical and general engineers, Pilgrim Street, Newcastle-on-Tyne, have dissolved partnership. Mr. Gradon will attend to debts and continue the business in his own name.

At meetings of Messrs. Cuttriss, Wallis & Co., held at the offices at Leeds on January 9th and 26th, resolutions were passed winding up voluntarily, and appointing Mr. J. W. Close, of 7, Greek Street, Leeds, liquidator.

The Electric Light in the Treatment of Consumption.—Mr. William Lynd has just concluded a course of lectures in Bournemouth on the therapeutics of heat and light, given with a view of introducing the Dowsing radiant heat and light treatment, in conjunction with the open air method of treating consumption, now engaging the attention of a large number of medical specialists. The bacilli of tuberculosis are rendered inert under blue light at a temperature of 116° F. and destroyed at 160° F. At a large sanatorium, where the "hut system is in operation," Mr. Lynd has been making some experiments with one of Mr. H. J. Dowsing's radiators, and the patients have been able to turn on an "electric sun" whenever the great natural luminary has not been available. Not only have the consumptive patients been able to enjoy the warmth without having the air polluted by the products of combustion, but they have also been bathed in the germicidal light available at all hours of the day and night. The leading medical men of Bournemouth have displayed great interest in the experiments which are being made with the Dowsing Radiant Heat and Light Apparatus. Next week Mr. Lynd will lecture in the operating theatre of the Hastings Hospital to the members of the Hastings Medical Association, on the Dowsing electric radiant heat and light treatment.

Electrical Exports for South Africa.—*The British and South African Export Gazette* says that electrical materials exported from the United Kingdom to South Africa during the four weeks ending January 16th, were valued at £6,390, against £7,865 in the corresponding period of 1899. A large proportion of the material is for the tramway and electric light installations at Durban and East London.

Fire.—The premises of Frederick Jones, Limited, electrical engineers, Sellers Street, Chester, were attacked by fire on Thursday evening last, and a good deal of electrical apparatus destroyed.

Foreign Electrical Goods and Apparatus in England.—Several alterations and additions have been made in the Board of Trade returns in the first issue for the current year. So far, however, as the electrical trade are concerned, the only item of interest is that imports of foreign electrical goods and apparatus are accorded a separate heading, the total of such imports during January being given as £63,153.

Society of Model Engineers.—The ordinary monthly meeting of the Society of Model Engineers was held at the Memorial Hall, Farringdon Street, E.C., on February 7th, Mr. Percival Marshall, A I Mech.E, presiding. A very interesting paper on "High Tension Electricity" was read by Mr. Stanley J. Harding, and was illustrated by a number of very effective experiments with induction and Tesla coils, vacuum tubes, and X ray apparatus.

The South Wales Power Scheme.—A conference of the local authorities affected by the South Wales Electrical Power Distribution Company's Bill was held on Wednesday last week at Cardiff, in response to a circular sent out by the town clerks of Cardiff, Swansea, and Newport. A resolution was passed to the effect that the Bill should be opposed on second reading, and that the local authorities of each borough and urban district in the counties of Glamorgan and Monmouth which are affected by the Bill be requested to bring the matter before their members of Parliament, and urge them to support the opposition to the Bill, especially on second reading, which will take place in the course of a few days. It was next resolved:—"That a petition to oppose the Bill on second reading be prepared and forwarded to the several local authorities within the proposed area of supply, and that they be asked to adopt it and present the same to Parliament." It was also resolved that the members of Parliament in South Wales and Monmouthshire be urged to oppose the following Electric Power Bills in the various stages through Parliament:—The County and City of Dublin Electric Lighting, Lancashire Electric Power, and Tyneside Electric Power. Further, it was resolved that the local authorities be at the same time requested to consider the propriety of putting themselves into a position to oppose the South Wales Electrical Power Distribution Company's Bill on its merits, in the event of the second reading being carried.

Trade Announcements.—In further reference to our notice of 19th ult., Mr Edward Lomer, 12, St. Mary Axe, E.C, informs us that his agency for the Accumulatoren Fabrick A.G., of Berlin and Hagen (Westphalia) refers only to export orders for the Colonies (except Canada) and other oversea markets.

Turner v. Brinsmead.—In our report of this case in ELECTRICAL REVIEW of the 2nd inst., we are informed that two slips have occurred in the evidence of Mr. R. A. Smith, viz, on page 173, top left-hand column, *re* voltage, Mr. Smith considered that the design of switch, press-button, and other devices was quite unsuitable for so *high* a voltage as 200, and these were only such as might have been used on a low voltage, such as a bell circuit. On line 16, same column, 78 inches, should read 18 inches to 20 inches.

Watches for the Leeds Rifles.—The members of the Leeds Rifles who are going to the front this week have all been presented by Mrs. Tannett-Walker with one of S. Smith & Son's (9, Strand), best English Keyless lever "Strand" watches in silver, having the name of the donor and the recipient engraved on the back.

ELECTRIC LIGHTING NOTES.

Blackpool.—A Local Government Board inquiry was held at Blackpool on the 6th inst. into the Corporation's application to borrow £42,515 for the purpose of electric lighting. The town clerk stated that it was the fifth application for sanction to borrow money for electricity. Since 1893 £120,000 had been borrowed. The consumers had increased from 112 to 900. It was absolutely necessary, with a view to meeting increasing demands and providing for the trams, that the works should be extended. There was no opposition, and the inspector intimated that he would report favourably.

Mr. R C. Quin, electrical engineer to the Blackpool Corporation, has been appointed to act in a similar capacity to the Shiply District Council, which has decided to apply to the Local Government Board for sanction to borrow £22,000 for electricity works. The West Bromwich Corporation, for whom Mr. Quin is also acting as consulting engineer, has just let tenders for £50,000 for electric light purposes.

Bradford.—On 7th inst. the Electricity Committee met for the purpose of appointing an electrical engineer in the place of Mr. A. H. Gibbings, who has resigned. There were originally 10 applicants for the position, and of these the following four had been requested to appear before the committee:—Mr. C. A. L. Prussmann, resident electrical engineer, Doncaster; Mr. R. A. Chattock, superintendent engineer, City of London Electric Lighting Company; Mr. John Christie, resident station engineer, Glasgow; and Mr. H. F. Street, electrical engineer, Halifax. The committee ultimately decided to recommend Mr. Chattock to the Council for appointment.

Bristol.—The Bristol Electrical Committee have decided not to employ an outside architect for the new station at Avonbank, but that the work shall be done through their electrical engineer's office, with the aid of a draughtsman to be appointed by the Committee as a member of the staff. This course has produced a strong protest from Mr. Henry Williams, the architect who has up till now been advising the Committee. The Committee had been in hope of extending their present station by securing additional land adjoining it, and in this matter Mr. Williams acted for them. It was found that the land procurable for such extension was very limited and expensive; a large site was therefore purchased at Avonbank, and Mr. Williams was instructed to see to the foundations for the new building. Then the Committee appear to have considered the possibility of reducing the expenses, and to have decided to dispense with an architect for the superstructure by advertising in the ELECTRICAL REVIEW for a draughtsman. They procured one, and now ask the Council to sanction his appointment. Mr. Williams thinks he has not been fairly treated, and argues that he has been

unconditionally appointed architect to the Committee. From this the Committee dissent. The matter is expected to give rise to a good deal of discussion in the Council.

Cardiff.—A special meeting of the Cardiff Electrical Committee was held on Monday last week for the purpose of inquiring into failures in the electric lighting, in particular on October 8th and 9th. The reports of the engineer, Mr. Appelbee, his assistant, Mr. Teasdel, and the mains superintendent, Mr. Pengelly, had been forwarded to the members of the committee.

At the outset a resolution of the Council, dated March 9th, 1896, was read. By this resolution the entire control of the staff of the electrical works was vested in the electrical engineer, and the chairman said he recognised Mr. Appelbee as the executive chief of the whole staff. It was pointed out that Mr. Appelbee had been interfered with in his authority, and that therefore the blame rested with the committee. In answer to questions, Mr. Appelbee said the committee put pressure on him to appoint Melhuish, but at the same time he accepted all responsibility. The preliminary discussion was as to whether the engineer had complete control over those he appointed only and not over those appointed by the committee. Upon a vote being taken the committee decided that the engineer should have complete control of the whole electrical staff subject to the action of the committee.

The committee then proceeded with the inquiry as to breakdowns. Mr. Appelbee in his report said:—"On the rectified arc circuits the 'A' circuit was out practically the whole night of October 9th, and two lamps on the following night. With these exceptions the arc lamps had been fully maintained as usual. The cause of the failure of the arc lights was due to the condition of the mains and not the rectifiers. The mains were defective in that water had found its way into six or seven of the joint boxes, the presence of which was not revealed by the daily test as to their condition. The responsibility for the presence of this water must be divided between Mr. Teasdel and Mr. Pengelly; the former, because during Pengelly's holidays he had men working on some of these boxes and who did not rejoint them, and the latter because water was found in one box where he had omitted to have all the fixing screws replaced at some time in the past. I consider the conduct of Pengelly in going home to tea as he did on the 10th inst., whilst the lamps were still out, and for not keeping in touch with Mr. Teasdel over these repairs, is open to severe criticism. It is very doubtful in my mind as to what time the lights would have been on again had not Mr. Teasdel late in the afternoon taken up the work of finding the faults while Mr. Pengelly was at tea, and restoring the service."

Mr. Appelbee said he accepted all responsibility for the past failures.

Mr. Teasdel's report gave details of the positions of the faults and of the steps he took to eliminate them while Mr. Pengelly was getting his tea, with the result that by 7·20 p.m. all the lamps but two were burning properly. Mr. Pengelly's report described his attempts to set matters right, which were unsuccessful, and resulted in his going home to tea.

A further report by Mr. Appelbee referred to the failures which occurred on subsequent dates; these were unimportant, lasting only from half a minute to five minutes, and nearly all took place after midnight. Most of them were due entirely to the rectifiers. Slight variations of speed, such as may occur in paralleling the alternators, have been known to throw the rectifiers out of phase, and to extinguish the arc lamps. A few slight failures of part of the private lighting were traceable to water in a sub-station, and to the blowing of transformer fuses. While the mains superintendent was to blame, it should be taken into account that the system is in course of being changed over from 100 to 200 volts, and the network is cut up into small sections, so that if one transformer or fuse fails, the other transformers cannot render assistance as they usually do.

A prolonged discussion took place, during which it was pointed out that the Ferranti contract trial had lately occupied a great deal of the engineer's time. It is not necessary to reproduce the details of the discussion; in the end it was resolved:—

(1) That the chief of the department have complete control over all the men in the employ of the Electric Lighting Department, including the deputy electrical engineer and mains superintendent. (2) That the chief of the department have power to engage and discharge all employés, with the exception of the deputy electrical engineer, mains superintendent, and clerical staff, whom, however, he may suspend at his discretion until the cause of complaint may be considered by the Committee. (3) That notice of motion be given to rescind any resolution inconsistent herewith.

Mr. Appelbee, therefore, is now in the position in which he should have been placed from the first, and will be able to exercise a free hand in the execution of his duties. We hope we have heard the last of "breakdowns at Cardiff!"

Carlow.—A gas explosion occurred in one of the manholes of the electric conduits on the 7th inst. No one was injured.

Chertsey.—The Board of Guardians has concluded an agreement with the Electrical Power Distribution Company.

Colne.—The Town Council will oppose the Lancashire Electric Power Bill; it is about to proceed actively with the erection of an electricity works.

Dartmouth.—The Town Council has approved an agreement with the electric lighting company, and has engaged Mr. J. G. W. Aldridge, Westminster, as consulting engineer.

Newcastle.—The Corporation last week finally decided to undertake the electric lighting of the streets on its own account.

Durham.—The Town Council has decided to support a Bill promoted by the Electrical Power Distribution Company, and a plan from the same company for a generating station in Durham has been agreed to.

Gateshead.—The Town Council has decided to oppose the Bill promoted by the Tyneside Electric Power Company, Limited, and to support that of the County of Durham Electrical Power Distribution Company, Limited, with which it has concluded an agreement.

Grantham.—The Town Council last week formally consented to the application of the Urban Electric Supply Company Limited, to the Board of Trade for a provisional order for electricity supply in the borough.

Hammersmith.—The Vestry has just decided to make another important extension in the street lighting. The Electricity and Lighting Committee recommended that, as an experiment, the whole of The Grove be lighted by alternating current arc lamps, at an estimated cost of £941, so that the effect might be judged before proceeding further with the street electric lighting. The recommendation was adopted.—The following figures were given as showing the effect of the recent reduction in the price to consumers. The figures indicate the saving so far as the Town Hall is concerned. For the December quarter, 1898, 4,016 units cost £87 19s. 8d.; for the December quarter, 1899, 4,230 units cost £69 6s. 3d., making a net saving of £18 13s. 5d.—The Electricity and Lighting Committee report that they have obtained tenders for wiring the works' extensions, but as the Vestry's engineer's estimate of £275 was well below the lowest tender, they recommended that he be entrusted with the carrying out of the work at this figure. The Vestry agreed.

Heywood.—The Town Council has approved of the electric lighting scheme submitted by the electrical engineer, Mr. W. P. Adams, and has resolved to apply for the necessary borrowing powers. It has also decided to oppose the Lancashire Electric Power Distribution Company's Bill in Parliament.

Leeds.—The City Council last week approved of the report of the Lighting Committee on the electric lighting extensions, in accordance with the recommendations of Messrs. Hopkinson and Talbot, which we quoted in our last issue. The Committee will, therefore, at once proceed with the provision of plant for electricity supply on the two-phase system at 50 frequency.

Leith.—The Town Council has received the sanction of the Secretary of State for Scotland to the borrowing of £10,000 for electric lighting extensions.

London—Greenwich.—The District Board of Works has resolved to request the London County Council to exercise all the powers it may possess against the London Electric Supply Corporation, Limited, to secure a better service to the consumers.

Bermondsey.—The Vestry has resolved to award compensation, between the limits of £2 and £10, to the tenants of 46 houses which are to be demolished to make room for an electricity works.

Manchester.—At a recent meeting of the City Council Sir John Harwood, chairman of the Water Committee, drew attention to a special report, in which it was suggested that there was injury to the city water mains by electrolysis. The report stated that Mr. Holme Lewis, the engineer and manager of the hydraulic supply, had made investigations, and found in many cases of burst lead service pipes that had occurred recently that it had been proved that they had been damaged by electrolytic action caused by the current escaping from the electric cables laid underground. The effect of this action was to pit the pipe, thus reducing its strength to resist the pressure of water. The attention of the Electricity Department of the Corporation had been called to the matter on several occasions and the pipes had been shown to them. With regard to iron mains, it was asserted that the result might be even more serious. After considering various reports, the Committee, Sir John said, had asked the Technical Instruction Committee to afford facilities for various experiments at the Technical School. The resolution of the Committee concludes:—"Should the various representations made be found to be substantially correct, this Committee is strongly of opinion that some action must be taken by them at once to obviate the damages which might ensue, as it will be quite manifest that if damage or deterioration of the water mains should be caused in the manner stated, and a number of large mains be affected, and burst at the same time, the consequences would be of a very alarming character." Proceeding, Sir John said it had been found necessary to put in a new main pipe, which was to cost £25,000. Alderman Higginbottom expressed the opinion that many of the statements in the report were not correct. As the representative of the Electricity Committee, he wished to say that they were as anxious to discover if they were damaging property as anyone else. He pointed out, however, that the Committee conducted its works clearly under the stringent rules of the Board of Trade, whereas in America, where most of the deductions of the report were derived from, there were no such regulations. He thought it a matter for conference between the chairmen and deputy chairmen of the committees concerned. After considerable discussion the suggestion for a conference was adopted.

Nelson.—The Town Council will oppose the Lancashire Electric Powers Bill.

Newcastle.—At the last City Council meeting, Sir Charles Hamond, M.P., on the subject of the Tyneside Electric Power Bill, said the proposals contained in that Bill would lead to the opening of Newcastle streets to enable the promoters to apply electric power to places outside and not inside the city.—Several members objected that to oppose the Bill was to act on the dog-in-the-manger policy; but in the course of the discussion it was pointed out that the promoters sought a wayleave through the city without payment. It was agreed to enter opposition.

Newport (Mon.)—The number of consumers at the end of December last was 357, as against 264 at the end of 1898, and the total revenue for the quarter ending December 31st, was £2,982, compared with £2,164 in the corresponding quarter of 1898.

Plymouth—At a special meeting of the Electric Lighting Committee last week, a letter was read from Messrs. Pethick Brothers, stating that they could not accept the amount paid to them in settlement of their claim for the erection of the electricity works, and objecting to certain disallowances which had been made from the claim. The matter was referred to the town clerk and the borough surveyor.

Sevenoaks.—The District Council has appointed a deputation to make inquiries and to visit electricity works at places similar to Sevenoaks.

Shrewsbury.—At the Town Council meeting on Monday the following report from the electric lighting department was adopted:—

The alterations and additions to the buildings are now practically completed, and the work of fixing the new machinery at the central station is proceeding satisfactorily. The boilers are now fixed in position, and all the fittings attached to them. The economiser is fixed, and new dynamo and engine are in course of erection. Some delay has occurred through the inability of the contractors to get steam piping, the makers of which are working night and day on Government contracts. The erection of the arc lamp standards is nearly all finished, and the work of laying the cable for these lamps is well in hand.

Sleaford.—The Urban District Council has resolved to consult Mr. Vesey-Brown, of Lincoln, before commencing to carry out its electric lighting scheme.

South Shields.—At the Council meeting held on 7th inst. the following estimate was submitted by Mr. Jeckell, the borough engineer, and the Council sanctioned same, and authorised that application be made to the Local Government Board to borrow the money, and that the work be put in hand forthwith.

ESTIMATES.

Circulating pump	£650
Pipes and connections for pumps	1,000
Girders and fixing pump	150
Sub-station	250
Switchboards for sub-station	300
Transformers	3,400
H.T. and L.T. cables	20,000
Pipes and trenches	9,000
Connecting in consumers	9,000
	£36,750

After correspondence with the Tyneside Electric Power Company and the County of Durham Electric Power Supply Company, the Council was advised by the Electric Lighting Committee to oppose the Bills unless South Shields be excluded from the area of supply.

Southend.—The Corporation is wanting a temporary architectural assistant for the preparation of plans for a lighting and tramway station.

Southgate.—The District Council has resolved to petition Parliament against the Bill of the North Metropolitan Electric Supply Company.

Tonbridge.—With further reference to the question of the appointment of consulting electrical engineer to the Urban District Council, we gather from a report in the local paper that at last week's Council meeting, the Electric Lighting Committee came forward with a report as follows:—

A full meeting of the Committee has considered the correspondence read to the Council at its last meeting, and has also considered the terms upon which Mr. Medhurst would be prepared to act as consulting engineer to the Council. These terms are 5 per cent. on capital outlay; the fee for report already paid by the Council to merge in such commission. The Committee recommend that Mr. Hammond be employed to make a preliminary report at a fee not exceeding 50 guineas.

The report seems to have excited a lengthy and at times acrimonious discussion.

Mr. Race, the chairman of the Committee, moved the adoption of the report, and said the recommendation was carried by a majority of five votes to two, seven members attending the meeting. A little explanation was due to the Committee as to what transpired at the last meeting of the Council. The Committee was appointed some three years ago, and that Committee had been giving their best time and attention to the matter ever since. At the last ordinary meeting of the Council the bulk of that Committee were absent, at any rate four of the working members, he might say, were absent, and he thought the Council might have adopted the course of referring to the Committee any correspondence which had not previously been before them. Personally he had taken a lot of interest in the matter, and so had the other members of the Committee. They had given days away from their businesses, paid their own expenses to visit other works, and he did not think they deserved to be treated as they had been at the last meeting by the matter being dealt with as it was. He was glad to see a full Council that evening. He had hitherto found that a considerable number of those on the Council were strongly in favour of electric light, and a small minority against it. He now asked the Council to use their judgment in deciding upon the recommendation of the Committee. He challenged anyone to produce anything in the nature of a resolution that had made Mr. Hastings Medhurst their consulting engineer. The matter was left to the Committee, and the Committee employed that gentleman to furnish a report for 20 guineas, which was paid to him, and he (Mr. Race) thought the clerk would bear him out when he said that Mr. Medhurst had no right to assume that he had any claim to any further work in Tonbridge. The 20 guineas which was paid to Mr. Medhurst was, in his judgment, a full and sufficient payment for the amount of work done. Then, after a while, the Committee were brought into contact with other electrical engineers, amongst them Mr. Robert Hammond, who at the present time was absolutely at the top of the tree in his profession. The Committee, desirous that they should have the very best man that money would procure, recommended the Council to approach Mr. Hammond and inquire as to his terms, &c. Immediately that became public Mr. Medhurst walked up and said he had got a preserve at Tonbridge, a monopoly; and that was what he (Mr. Race) strongly objected to. It was very clever, no doubt, on the part of Mr. Medhurst, and a nice way of restricting work to himself. By electing Mr. Hammond they would be choosing the very best man. Many towns had had two reports. By having two reports they were able to compare them and decide which was the best. And was £20 a large sum to spend on a report when they were contemplating the erection of works which would cost about £17,000 or £18,000?

Mr. Little seconded the adoption of the report.

After lengthy discussion, Mr. Jones then moved an amendment calling upon the chairman of the Electric Light Committee to state the reasons why the Committee did not approve of Mr. Medhurst's report.

The Chairman replied that he could not accept the amendment, as it was a direct negative to the proposition.

Mr. Jones then moved that Mr. Hammond's name should be deleted from the report, and the recommendation that he should be asked to furnish a report struck out.

The amendment of Mr. Jones was then put and lost, seven voting for it and nine against.

Mr. Jones next moved that tenders should be invited for the carrying out of the works, and Mr. Broom seconded, but after a little discussion this was also lost.

Mr. Broom was the mover of amendment No. 3, that Mr. Boet, of Tunbridge Wells, should be appointed consulting engineer, but this met the same fate, only six voting for it.

Amendments were now becoming as plentiful as blackberries in autumn. Mr. Jones moved that Messrs. Ellis & Ward, of Birmingham, should be the Council's engineers, Mr. Broom seconding, and extolling the virtues of a firm he knew nothing about. This, too, was lost.

Mr. Batcher was the proposer of No. 5 amendment, the favoured engineer being Dr. Kennedy, who had carried out works at Belgravia, Pimlico, Westminster, and other places. Mr. Johnson seconded, and Mr. Broom was a ready champion of the Professor's abilities. "Lost" was put to the account of this amendment.

Mr. Jones moved that the matter should be referred back to the Committee for further consideration. Mr. Johnson seconded, and Mr. Broom once again championed the cause with his usual eloquence. This, notwithstanding, was lost by seven votes to nine.

Mr. Race then moved the closure, and by ten votes to six the Committee carried their recommendation.

Walsall.—At the meeting of the Town Council on Monday last, the Electric Lighting Committee reported that after paying interest and sinking fund there was a profit of £61 13s. 5d. for the year ending December 31st last, as against a loss of £279 3s. 11d. for the previous year.

Warrington.—The Local Government Board have sanctioned the borrowing of a sum of £44,966 by the Town Council for the purpose of electricity supply.

West Hartlepool.—The Town Council will oppose the Bill of the County of Durham Electric Power Supply Company, as regards the provisions affecting the Hartlepools.

Withington.—The Council has resolved to join the Stretford Council in opposing the Lancashire Electric Power Bill.

Woodstock.—The Lighting Committee has resolved to recommend that the Town Council consent to the application of Messrs. Musker & Co. to the Board of Trade, for a provisional order for electricity supply.

Worcester.—The City Council has resolved to pay discounts in cash instead of in lamps, owing to complaints from the consumers. It has also decided that the Council's claim against Messrs. Ferranti for £700, the penalty for delay in completing a steam alternator, should be waived, and the company's offer to increase the capacity of the plant from 300 to 400 KW. should be accepted in its stead.

Yeadon.—The District Council have received a report prepared by Mr. Enright on the subject of an electricity supply, in which a scheme is outlined involving an outlay of £12,600. The matter is under consideration. The Council possesses a provisional order, and was warned two months ago that it would be revoked unless put into operation within one year.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—A special meeting of the Barnsley Town Council was held last week for the purpose of confirming or otherwise the promotion of a Bill in Parliament for various purposes, including the construction and working of tramways in Barnsley. The British Electric Traction Company, though opposed by the Corporation, some time ago obtained an order empowering them to construct light railways in the borough, and negotiations have been proceeding between the Council and the company. Alderman Holden, the chairman of the Tramways Committee, last week reported the result, and moved a resolution withdrawing the proposed application to Parliament, and confirming the agreement with the company. Alderman Holden said that whilst they were all agreed that tramways would be of great benefit, they could not recommend the town to embark upon an expenditure of £100,000 (as estimated by the borough engineer) to establish an adequate system of tramways, with the uncertainty as to their financial success. They had, he thought, obtained fair and reasonable terms from the Electric Traction Company. The company had agreed to construct within three years an efficient scheme of tramways for the town and district, and, after 12 months' working, the Corporation were to have the option of purchase. If they purchased they could lease the lines to the company for a term, and the company would pay an amount equal to the interest and redemption of the purchase money for a specified period. The company also agreed to buy their electrical energy from the Corporation at a price which their expert advisers told them was satisfactory. The Corporation retained their control over the roads.—The resolution was carried.

Bristol.—A few weeks ago the relations between the Bristol Sanitary Committee and the Bristol Tramway Company, now reconstructing their system for electrical traction, were described as "somewhat strained." A striking confirmation of this has been afforded by correspondence which has since taken place between the company and Committee. The secretary to the company wrote on February 5th complaining that the Committee had absolutely failed to carry out the agreement made in April, 1899, to wood-pave the sides of certain streets where the company's lines have been laid. The practice in Bristol is that the company lays and maintains the road between its lines, and also for 18 inches outside its metals—an arrangement practically amounting to a substantial wayleave. A number of streets were agreed upon in which the company was to pave their part with wood blocks conditional on the Committee doing the rest of the street. The letter, pointing out that this agreement had not been acted upon, complained somewhat bitterly of the Committee's inaction, and stated that the result of it was the company's margins were knocked about through the city's failure to complete the work, and the public preference for the wood has thrown an unfair amount of the traffic on to the company's track. The company demanded a date by which the Committee would carry out their contract, and stated that, failing this, they would have to institute legal proceedings. The city engineer's reply breathed a somewhat indignant tone, and challenged the correctness of the company's assertions. The letter pointed out that the Committee had not been inactive, but had applied for Local Government Board authority to borrow the money for the wood paving, and without waiting for the sanction had invited tenders for the wood, but only to find the conditions of the market prevented early delivery. The city engineer declined to commit his Committee to a date, and the Committee, when the correspondence was reported, decided to take no notice of the matter. On February 10th the tramway secretary returned to the attack, and declared that the Committee's course, if persisted in, would leave the directors "no alternative but to request the company's solicitors to institute the necessary proceedings to require specific performance of the agreement of April last and damages for the non-fulfilment."

A serious accident occurred in the course of erecting the Tramway Company's new electrical power house. The contract was let to an American firm—the Riter Conley Company, of Pittsburg—and they sent over their own workmen from the States to do those parts of the work requiring special skill. While a huge girder weighing about 10 tons was being hoisted into place the rope broke and it fell about 50 feet. Three men were going up on it, and one was killed by the fall and the others very seriously injured. At the inquest it was shown that all precautions had been taken, and that the rope should have stood many times the strain put upon it. The reason it snapped no one could say, but there was a suggestion that the frost might have had something to do with the matter.

Cardiff.—At a meeting of the Town Council on Monday, the Tramways Committee recommended that sanction be given the committee to visit Liverpool, Glasgow, Hull, and Bradford, and advise the Corporation as to the best system of generating power for tramway traction, and after the Corporation has decided thereon, that an electrical traction engineer be appointed to carry out the adopted system, at a commencing salary of £500. Councillor T. Andrews said it was proposed to expend over a quarter of a million of money on the project, and it was most important that no mistake be made. The committee were very anxious that there should be no experimenting in this matter, and that no mistake be made in a choice of a system, whether it was on the principle of a separate works or a joint light and traction generating station. When the proposed tramways were in working order, there would be a profit of £10,000 a year. Alderman Carey said the Halifax Corporation sent a deputation to America and Canada before the town came to any conclusion as to the principle of generating station to be adopted. Councillor Robinson proposed an amendment that an electrical traction engineer be first appointed, and that the committee should then advise the Corporation as to the system to be adopted. Councillor Hallett seconded. Alderman Carey said the only objection to the amendment was that the engineer whom they appointed might be prejudiced in favour of one system. It was better, he thought, to make an exhaustive independent inquiry before appointing their engineer. Councillor Fox strongly supported the amendment. Councillor W. L. Yorath said by first selecting their system, they would be releasing the subsequently appointed engineer from all responsibility should the system prove a failure. Councillor Morgan Thomas could not see any necessity for the deputation, but Councillor Chappell thought the scheme so important, that the fullest possible information should be obtained. The amendment was carried.

Dublin.—Last week the Dublin United Tramway Company extended their electric tram system from College Green to Drumcondra. The only line now being worked with horses is that from Haddington Road to Sandymount. The work of constructing the new route, which will be by way of Ringsend, is being pushed forward.

Gloucester.—The Earl of Jersey and Colonel Boughey, light railway commissioners, held a public inquiry at Gloucester on 12th inst. with reference to the application of the City of Gloucester Tramways Company, Limited, for an order authorising the construction of a light railway for the city and district. There was practically no opposition to the scheme.

Greenock.—The Police Board has appointed a subcommittee to consider the tramway offers received, with powers to confer with the offerers and report. One of the speakers at last week's meeting said that financially the offer of Mr. Murphy was much the best.

Grimsby.—The Grimsby Street Tramways Bill came before the Examiners of Private Bills on 12th inst. The Examiners formally marked the Bill as not having complied, but that the necessary proofs were submitted save the consent of the Corporation.

Liverpool.—At the City Council meeting last week, Alderman Petrie moved that the estimates for the tramway expenditure, amounting to £600,000, be approved. There was an increase in the receipts from the tramways. Since the beginning of the present year the increase had gone on week by week, and last week's receipts were £1,000 over the sum received in the corresponding week of last year. The Committee propose to enter thoroughly into the work of extending the tramway service. For instance, they proposed double lines up William Brown Street, Islington, Erskine Street, Moorfields, Boundary Street, and other streets. It was necessary that the engineer should be allowed a free hand in constructing the lines, so that he should keep his staff fully employed. The electric tramways were paying very well, and the public appreciated them, so that the best policy would be to go on with the work as soon as possible. The estimates were approved.

London Electric Tramways.—On Monday the examiners of standing order proofs of the House of Commons had before them several Bills relating to proposed new tramways in the south-east and other parts of London. Mr. Cripps, Parliamentary agent to the County Council, stated that in the case of the London County Tramways (No. 1) Bill, which has for its object the construction of new tramways in Hampstead, St. Pancras, Camden Town, Islington, Clerkenwell, Streatham, and Bromley, this was the first time that a Bill of this sort, involving large tramway powers for the L.C.C., had been brought before Parliament. As might be expected, several points of principle had arisen between the L.C.C. and the various local authorities, and it had, therefore, been arranged to hold a conference on the 23rd inst. to discuss those matters. After the conference it would take some time for the amendments agreed upon to be prepared and for the consent of the local authorities to be obtained. He asked the Court to allow the case to stand over to the 26th inst., when he would submit proofs of compliance with the rules of Parliament. The examiners assented to the course proposed. The consideration of the London United Tramways Bill was postponed until 19th inst., and the consideration of the London County Tramways (2) Bill was also postponed. The object of the last named (says the *Times*) is to enable the L.C.C. to work their tramways by electricity. In the case of the South-Eastern Metropolitan Tramways Bill, Mr. Lees, of the firm of Baker, Lees, & Co., gave formal proofs as to that part of the Bill relating to electric motive power, but a report of non-compliance with standing orders was made in regard to those provisions relating to new tramways, the necessary assent of the L.C.C. to the scheme not having been obtained.

Pembroke.—The Urban Council has received a letter from the solicitors of the Council, Messrs. D. and T. Fitzgerald, stating that a settlement had been arrived at in relation to the question of the laying by the Dublin United Tramways Company of conduits for their electric wires within the township, which had been the subject of a suit (see last week's Electrical Review under "Legal") before the Master of the Rolls, who had granted an interlocutory injunction prohibiting the laying of the conduits outside the Tramway Company's paved parts of the roads. The agreement provided that the injunction should be made perpetual; that the conduits already laid in the macadamised part of Merrion Road, from Dornden House to Elm Park should be taken up, if these should be found to interfere with the works of the Council, the question as to whether they did or not to be submitted to arbitration; and all the costs to be paid by the Tramways Company. Accompanying the letter was a draft agreement. The agreement was ordered to be sealed preliminary to being made a rule of court.

Mersey Railway.—Yesterday (Thursday) a meeting of the Mersey Railway Company was held at Cannon Street Hotel to consider further expenditure upon its Bill, one of whose objects is to work the line electrically. Cable haulage having been declared unsuitable, the opinion of experts, Sir W. Preece and Major Cardew, was taken upon electric traction. They have reported strongly in favour of electric traction, and recommended the adoption of a system by which the train service will be greatly increased and accelerated, and they estimate that the following results may be expected from its adoption:—

Present gross receipts for year ending June 30th, 1899	£75,775	
Present gross expenditure (exclusive of directors' fees) for year ending June 30th, 1899	64,385	
Net revenue at present..		£11,390
Saving in working expenses by electrical working		11,540
Increased gross receipts at the end of first year		18,948
		£41,878
Less interest on maximum new capital, £428,750, at 4 per cent. (It is hoped that a smaller capital will be sufficient, and that it may be raised at a lower rate.)..		17,150
Improved estimated net revenue (including the existing net revenue) at end of first year's working after providing for interest on maximum new capital		£24,728

After allowing an adequate sum to capital reserve for depreciation beyond the yearly repairs met in the working expenses, they further estimate that in three years after the adoption of electrical working the net revenue will be increased to £41,666, and that this improvement by no means exhausts the possibilities of the altered system. Much more, they consider, may result from it. The adoption of electrical working on the lines recommended in the report of Sir William Preece and Major Cardew will not in any way interfere with the use of the tunnel by steam locomotives to any extent that may be found necessary. These estimated results show the importance of the question, and everyone responsible for the management of the company's affairs, including the receivers and managers, the board, and the engineers, and others whom they have consulted, is agreed that electrical working should be adopted. It is considered that with certain anticipated competition the present net revenue of £11,390 may disappear altogether unless electrical equipment is proceeded with.

Salford.—At last week's meeting of the Borough Council, Alderman Linsley moved a resolution to the effect that the Tramways Committee should provide and fix the poles and overhead wires for the new electric tramways system, and that the Electric Light Committee should be requested to undertake the maintenance of the overhead wires when fixed. He said that for some time there had been a certain amount of friction between the Tramways Committee and the Electric Light Committee as regarded which of the two committees should undertake the work referred to. Both committees had given way on several points connected with the electric tramways scheme, and he thought if they accepted the arrangement proposed in the resolution it might remove the friction. Mr. Barnes seconded the resolution, which was opposed by Mr. Haworth. The latter gentleman said that in 1898 the Tramways Committee passed a resolution asking the Electric Light Committee to undertake the work, and as the latter committee had obtained sanction to borrow the money he thought they should be allowed to go on with the work. After further discussion, Alderman Phillips moved as an amendment "That the Electric Light Committee fix and maintain all plant up to the point of contact of the trolley wheel and overhead wires required to work the tramways, and charge the capital cost and maintenance thereof to the Tramways Committee, and that the Electric Light Committee charge for electric current separate from any cost of maintenance or other expenses whatsoever." This was seconded by Mr. Foden. The amendment was carried, the resolution passed by the Tramways Committee in 1898 having been previously rescinded.

Stirling and Bridge of Allan.—Stirling and Bridge of Allan tramway shareholders have sanctioned a provisional agreement by which the tramways will be transferred to the British Electric Traction Company, the consideration being £30,000.

Tonypandy.—At a representative meeting held last week a resolution was unanimously passed requesting the Rhondda Urban District Council to use every effort to come to an amicable arrangement with the British Electric Traction Company, in order that the present opposition to the light railway scheme to Tonypandy be withdrawn, the meeting being of opinion that more frequent means of intercommunication with the lower parts of the valley and Tonypandy would be a very great public advantage. It was also decided to request the Council to endeavour to obtain a pledge from the British Electric Traction Company that they will apply on the earliest possible date for powers to extend their present projected line from the square at Tonypandy to Treherbert, and from Porth through Tylorstown to Ferndale.

TELEGRAPH AND TELEPHONE NOTES.

The American Pacific Cable.—A Reuter despatch from Washington says that the Inter-State and Foreign Commerce Committee in the House of Representatives had decided by eight votes to five to report the Pacific Cable Bill, after rejecting a proposal for Government ownership of the cable.

Grantham Telephones.—At the quarterly meeting of the Town Council last week, it was decided to petition the Postmaster-General for a license under the Telephone Act, 1899, authorising the Corporation to provide a system of public telephonic communication in an exchange area comprising the borough of Grantham and the neighbouring rural parishes. Major-General Webber was authorised to make the application on behalf of the Council.

Imperial Telegraphic Communication.—At a representative conference held on Wednesday at 25, Park Lane, the following resolution was passed:—

That, in the opinion of this conference, it is urgent that a Select Committee of the House of Commons, composed of business men, be appointed to inquire into the position of the cable companies communicating with our Eastern colonies and dependencies, especially in relation to the Imperial Government and the Indian Government; and that Sir Edward Sassoon, M.P., Sir John Leng, M.P., Mr. C. McArthur, M.P., and Mr. Holland, M.P., be appointed to wait upon the Chancellor of the Exchequer to ask the assistance of the Government with this object in view.

The London Telephone Service.—The Highways Committee of the London County Council reported that their attention had been called to a notice issued by the National Telephone Company to all its subscribers in London, in which it was stated that the snowstorm which occurred on February 2nd had caused a partial dislocation of the London telephone service, and which also contained the following words:—

During the past four years the company has been using its utmost endeavours, but without success, to induce the London County Council to consent to the wires being put underground. Had the County Council done so the present trouble would not have occurred.

That statement, which the committee pointed out was sent to something like 15,000 persons in London, was not in accordance with the facts. If the company had in the course of the negotiations which had been proceeding offered terms which they could have advised the Council to adopt—terms similar to those given by the company to several provincial cities and towns—the matter could have been settled so far as the Council was concerned; although even in that event it would appear that consent given by the Council would be of no avail unless the company should first have obtained a license from the Post Office. In another report, says the *Times*, the committee state that the company had not yet obtained the Post Office license, but that it had, notwithstanding, carried out underground works at certain places, in some cases with and in some without the permission of the road authorities concerned, but it had not obtained the consent of the Council to the works. They had accordingly directed that proceedings should be taken against the company for infringing in this respect the provisions of the Telegraph Acts.

At Tuesday's meeting of the L.C.C., when the above reports came up, Mr. Benn, chairman of the Committee, said that the Council's clerk had received the following letter from Mr. Gaine, secretary of the company, dated yesterday:—

From a paragraph which appears in the *Times* of to-day I see that the Highways Committee is reporting to the County Council that a statement made by me in the circular which I recently issued to the National Telephone Company's London subscribers is not in accordance with fact; that, if the company had, in the course of the negotiations which have taken place, been ready to give terms to London similar to those given to several provincial cities and towns, the matter could have been settled so far as the Council is concerned; and that, even in that event, the consent of the Council would have been of no avail unless the company had first obtained the license from the Post Office. I think it right on the part of the company that I should state at once that I am prepared to prove to demonstration that the statement contained in my circular is strictly in accordance with the facts, that the company has always been willing to concede terms to London *ejusdem generis* with those conceded to provincial towns, and that the Highways Committee is fully aware that the Postmaster-General is under express covenant to give to the company the license they refer to whenever called upon by the company so to do. The position of the negotiations is at present in a nutshell. The company has offered that, if the County Council will consent to its putting its wires underground, it will supply the service at the same price and on the same terms as the Post Office, and the Highways Committee has asked in addition that the company shall give free intercommunication between its London subscribers and subscribers of the Post Office. This demand is impossible of acceptance. I see that the Highways Committee states that my circular was sent to something like 15,000 persons in London. As a matter of fact, it was sent to a much larger number, the number of the company's exchange telephones in London being now just 30,000.

Mr. Benn said that the statements of the committee were strictly in accordance with the facts. The company did not offer the same terms to London as they did to provincial towns. By the proposals of the Government London was deprived of its rights to a municipal service, and the duty of the Council was in this case to safeguard the interests of the telephone users. Mr. Westacott pointed out that while the Council and the company were quarrelling, the telephone users were suffering great inconvenience. After further discussion, the Highways Committee's reports were received and adopted.

At the last meeting of the Strand Board of Works, Mr. W. Emden in the chair, the Works Committee reported that they had considered the letters of the Postmaster-General stating that no authority having been conferred by him upon the National Telephone Company to construct telegraphs in the county of London, they commit a nuisance, and are liable to legal proceedings in disturbing a street, though with the consent of the local authority. They had also considered the letters from the National Telephone Company and the London County Council on the subject. They recommended that the company be informed that inasmuch as the policy of the Board has been to treat each application on its merits, and without assuming the right to give any more authority than it is empowered to give to the company, to offer no objection to their proposals to lay cables underground where it seemed more expedient than to have an increased number overhead. They also recommended that a reply be sent to the Postmaster-General stating that the Board does not feel able to take up any position inconsistent with the policy it has hitherto pursued; and to the London County Council, that, owing to the question at issue

between the Postmaster-General and the company, the Board would prefer that the Council should get the information they require from the company rather than the Board. Mr. C. J. W. Cull moved the adoption of the recommendations of the Committee, which was carried.

The Pacific Cable.—We reprint the following from the *Ottawa Citizen* of 24th ult.:—"A recent press report informs us that, contrary to the strongly expressed views of Lord Strathcona, the Colonial Office has assented to the granting of a concession to the Eastern Telegraph monopoly which may prove a death blow to the Pacific cable scheme. Referring to the long chapter of delays, the London *Outlook* says: 'We do not suppose that Sir Robert Herbert is in any way responsible for the delay.' Why should he be? That gentleman is, we understand, occupying the highest position next to Mr. Chamberlain in the Colonial Office. But the *Outlook* points out that Sir Robert Herbert is himself one of the cable monopolists. It states 'He is a director of the cable group.' Is this exactly as it should be? Canada and Australia have set their minds on the Pacific cable, believing it to be an undertaking worthy of the empire. Are they to be frustrated in their aims by an official in Downing Street, however exalted his position? Is the undertaking to be blocked year after year, and finally killed in the interest of rich London monopolists, who, as the *Outlook* correctly says, 'have far more influence in English public life than is good for the empire?' Canada indignantly protests against any further concession to the Eastern Telegraph Company, or any other cause of obstruction and delay. Nothing will satisfy us but the immediate commencement of the cable to connect us with our fellow subjects in Australia and New Zealand."

The Pacific Cable Committee held its third meeting at the Colonial Office on 13th inst. Sir Francis Mowatt presided.

The Post Office Telephone Service.—In the House of Commons on 9th inst. Mr. Hanbury, in replying to Mr. Trovand, said that the tariff and regulations for the Post Office London Telephone Exchange system were practically complete, but until the work of constructing the main system was also complete it had been thought better not to publish the details of the scheme.

Roumanian Telegraphs.—The Roumanian Post and Telegraph authorities in Bucharest are reported to be considering a proposition received from the Continental Röhren and Masten-walzwert, of Oberhausen, Germany, to replace the existing wooden telegraph poles in the different towns by steel columns.

Telegraph Charges between England and France.—Sir E. Sassoon, M.P., has received a letter from the French Minister of Posts and Telegraphs, from which the following is an extract:—

> In the course of recent negotiations . . . . the eventuality of a reduction of the telegraphic tariff between England and France was contemplated; but after examination it was recognised that this reform, which concerns State finances, should form the subject of a special study and could not well be decided on its own merits. The question, besides, seems one that will naturally come up for consideration before the International Conference, which meets in London in 1901. Its solution has, therefore, been postponed till then. The French Administration is disposed to accept a reduction in principle, if, when a proposal to this effect is made, the traffic has progressed in such a way as to throw no appreciable loss on the Treasury. But, in any case, it may be foreseen that the reduction will not amount to 50 per cent. when it is considered that the gross proceeds previous to 1868, the year when the 20 per cent. reduction was made, have only been reached again.

The Telegraph Wire Export Trade.—The new year has opened rather quietly in the export trade of the country in telegraph wire and apparatus connected therewith. Returns just issued show that the value of the shipments during January last only amounted to a value of £54,063, which compares with £46,964 in the preceding month, and £311,466 in the first month of 1899.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 28th. The Tramways Committee wants tenders for four electrically-equipped tramcars. See our "Official Notices" February 9th.

Birkenhead. — March 1st. The Corporation wants tenders for the supply and laying of feeder and distributing mains. See "Official Notices" February 9th.

Blackburn.—February 26th. The Corporation wants tenders for feeder cables for electric traction. See "Official Notices" to-day.

Bootle.—February 17th. The Corporation wants tenders for underground electric cables. See "Official Notices" January 26th.

Coatbridge.—The Town Council is anxious to receive proposals from companies willing to lay down electric tramways. See "Official Notices" January 26th.

Durban (Natal).—April 2nd. The Corporation is inviting tenders for 1,900 tons of steel girder rails, 64 tons of fishplates (bolts, bonds, &c.), 407 loads Australian hardwood stringers, &c, also the laying of same for 14·36 miles of single track, and bonding 2·96 miles of equivalent existing single track, the Corporation laying concrete foundations and making up roadway. See "Official Notices" February 9th.

Farnworth.—March 7th. The Urban District Council invites tenders for Lancashire boilers, economisers and other steam plant, three 120-kw. steam dynamos, lighting and traction switchboards, accumulators, underground cables, travelling crane, and re-cooler tower. See "Official Notices" to-day.

Germany.—February 23rd. Tenders are being invited until February 23rd by the Königliche Wasserbau-Inspection, at Emden (to whom they are to be addressed), for the supply of nine 3-ton electrical cranes. The specification may be obtained, on payment of 2s., from Herr van Jindelt, the Königlichen Bau-Secretär.

Germany.—February 28th. Tenders are being invited until the 28th inst. by the Prussian State Railway authorities at Hanover, for the supply of 27,000 porcelain insulators, four tons of insulated wire, and 224 tons of telegraph wire. Tenders are to be sent to Die Königliche Eisenbahn Direction, 7, Joachimstrasse. Hanover, whence particulars may be obtained on payment of 6d.

Glasgow.—February 17th. The Corporation is inviting tenders for the following:—(1) 200—300 motor car trucks; (2) 200—300 motors and equipments; (3) the supply, delivery, and erection complete of the overhead trolley constructional work required for the equipment of the system. Specifications, with form of tender, &c., and all other information, can be obtained on application to Mr. John Young, general manager, 88, Renfield Street, Glasgow. A bank draft for £5 5s., payable to the general manager, must be sent along with application for specification for each item. Deposits will be returned on receipt of a *bonâ fide* tender. Sealed tenders, marked "Tramways, Tender for ——," must be lodged with the Town Clerk, City Chambers, Glasgow, by February 17th.

Gloucester.—February 27th. The Corporation invites tenders for the wiring of the Guildhall, public baths and electricity works, also the necessary fittings. See "Official Notices" February 9th.

Horsham.—March 1st. The Urban District Council is wanting tenders for water-tube boilers, pipework, two steam dynamos, batteries, switchboard, 6-ton overhead traveller, mains, road work, enclosed arcs, and station lighting. See "Official Notices" January 26th.

Hull.—February 19th. The Corporation wants tenders for 35 double motor equipments and 10 car bodies. See "Official Notices" January 26th.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

Newcastle-on-Tyne.—February 22nd. The Tramways Committee wants tenders for copper bonds. See "Official Notices" February 9th.

Newcastle-on-Tyne.—March 2nd. The Tramways Committee wants tenders for 130 car bodies, trucks, and electrical equipment for same. See "Official Notices" February 2nd.

Newington.—February 20th. The Vestry wants tenders for two water-tube boilers, feed pump and extensions to steam and water mains at the electricity works. See "Official Notices" February 2nd.

Poplar.—March 1st. The Board of Works is prepared to consider schemes for fitting up consumers' houses for electric lighting, free of initial cost to the Board or consumers. See "Official Notices" this week.

Rochdale.—February 28th. The Corporation wants tenders for electricity meters. See "Official Notices" February 2nd.

Salford.—February 28th. The Corporation wants tenders for electrically-driven mechanical stokers, economisers, jet condensers, and pumps, with steam exhaust and water pipes, electrically-driven feed pumps, feed pipes, and travelling crane for their new electricity works. See "Official Notices" February 9th.

Sunderland.—March 2nd. The Corporation wants tenders for the supply of steam, exhaust, feed and other pipes, and two steam-driven induced draught fans and accessories. See "Official Notices" February 9th.

Walthamstow.—February 23rd. The District Council wants tenders for the supply of electric lighting and Dowson gas plant at the Isolation Hospital, Chingford. See "Official Notices" February 2nd.

Wimbledon. — February 26th. The District Council wants tenders for 25 lamp-posts for incandescent electric street lighting. See "Official Notices" to-day.

CLOSED.

Aberdeen.—The Gas and Electric Lighting Committee recently accepted the offer of the British Westinghouse Company Limited, to supply a 700-H.P. engine and dynamo for £5,092.

Barking.—The *Contract Journal* states that the following tenders have been accepted for the supply and erection of electrical plant, for the Barking Urban District Council:—Babcock & Wilcox (Section A) water-tube boilers, with fittings, economiser, feed pumps, &c., £1,704, (Section B) pipework, &c., in engine and boiler house, £506; Thames Ironworks Company (Allen) (Section C), two

five to report the Pacific Cable Bill, after rejecting a proposal for Government ownership of the cable.

position inconsistent with the policy it has hitherto pursued; and to the London County Council, that, owing to the question at issue

100-KW. steam dynamos, vertical enclosed high speed engines, £2,094; General Electric Company, Limited (Section D), main switchboard and connections, £506 10s. NOTE.—The Council have deferred the consideration of the tenders for Sections E, F and G of the plant until the tenders for the opening bridge and embankments are under consideration.

Felsted School.—The following is a list of the tenders for electric generating plant for Felsted School. The contract for the whole work has been placed with Messrs. Reavell & Co., of Ipswich, for £2,994. This price includes Crompton electrical machinery, Babcock boiler, Western Electric cables, and Chloride accumulators:—

SECTION 1.—Boiler, two 27-KW. Steam Dynamos, Condenser and Pipe Work, &c.

Reavell & Co. (accepted)	£2,318 10 0	Brush Elec. Eng. Co.	£3,067 10 0
Rooper & Robins	2 434 6 0	Christy Bros.	3,101 16 0
Johnson & Phillips	2,740 0 0	Foote & Milne	3,102 0 0
Ernest Scott & Mountain	2,767 0 0	,, (alternative)	2,870 0 0
Crompton & Co.	2,837 0 0	C. A. Parsons	3,159 0 0
G. Wailes	2,902 17 6	T. Metcalfe	3,885 0 0
Allen, Son & Co.	2,982 0 0	Elec. Construction Co.	3,341 0 0
Clark & Aiton	2,991 0 0	F. Nell	3,697 0 0

SECTION 2.—Accumulators.

*W. J. Fryer & Co. (P. & G. cells)	£415 0 0	Electrical Power Storage Company	£551 17 6
(Extra for Chloride, £66.)		Foote & Milne	580 0 0
Pritchetts & Gold	422 0 0	Rooper & Robins	584 0 0
Hart Accumulator Co.	425 0 0	Ashmore, Benson, Pease and Co.	587 0 0
Chloride Elec. Syndicate	483 0 0	Gudgeon & Co.	760 0 0
W. C. Horne & Co.	590 18 0	Cassells & Co.	789 0 0
Tudor Accumulator Co.	546 0 0		
Christy Bros.	549 6 0		

* Accepted as sub-contractor to Messrs. Reavell & Co.

SECTION 3.—Cables.

*Fryer & Co.	£354 18 11	Western Electric Co.	£690 0 0
British Insulated Wire Co.	468 17 0	Gudgeon & Co.	782 3 9
Foote & Milne	482 10 0	Johnson & Phillips	790 0 0
Christy Bros.	600 7 8	Glover & Co.	845 0 5

* Accepted as sub-contractor to Messrs. Reavell & Co.

SECTION 4.—Switchboard.

Gudgeon & Co.	£98 15 0	Scott, Anderson & Co.	£160 0 0
*Fryer & Co.	110 0 0	Foote & Milne	175 0 0
Middleton & Co.	126 0 0	Crompton & Co.	181 0 0
General Electric Company	126 0 0	R. D. Cassells & Co.	197 8 0
Electric Transmission Co.	130 0 0	Edison & Swan	250 0 0
Rooper & Robins	185 0 0	Elec. Construction Co.	260 0 0
Christy Bros.	158 0 0		

* Accepted as sub-contractor to Messrs. Reavell & Co.

France.—The French Post and Telegraph authorities has equally divided an order for 10,000 metres of iron pipes between La Société Francaise pour la Fabrication des Tubes of Louvroil, and M. Lemaître, of Hautmont (Nord).

Plymouth.—The Committee have accepted the tender of the British Westinghouse Company for steam dynamo and motor generator, at £6,217; and of Messrs. Ferranti at £5,296 for steam alternator; the tender of the Tudor Accumulator Company at £4,542 for accumulators; and that of the Callender Cable Company for underground mains at £7,054.

St. Annes-on-Sea.—The District Council has placed a contract with the British Insulated Wire Company for mains, and one with Messrs. Crompton & Co., Limited, for street arc lighting.

Tunbridge Wells.—The Council has accepted the following tenders for plant:—400-KW. steam alternator, Messrs. Ferranti, at £4,677; condensing plant, Messrs. The Klein Engineering Company, at £4,621; two Lancashire boilers, Messrs. Tinkers, Limited, at £3,060.

Walsall.—On the recommendation of the Electric Lighting Committee the Corporation have accepted the tender of Messrs. Babcock & Wilcox for supplying and erecting a boiler at the generating station at £510.

FORTHCOMING EVENTS.

Friday, February 16th.—At 7 p.m. Northern Society of Electrical Engineers. Annual dinner at the Grand Hotel, Manchester, Mr. Ferranti presiding.

Saturday, February 17th.—At 11 a.m. Institution of Electrical Engineers. Students' visit to Davies Street station of the Westminster Electric Supply Company.

Thursday, February 22nd.—At 2 p.m. The Institution of Electrical Engineers. Students' visit to the works of the Incandescent Electric Lamp Company, Brook Green, Hammersmith.

At 8 p.m.—The Institution of Electrical Engineers. "The Standardisation of Electrical Engineering Plant," by R. Percy Sellon, member; (adjourned discussion).

Friday, February 23rd.—At 5 p.m. Physical Society. *Agenda:* Prof. R. W. Wood, of the University of Wisconsin, U.S.A., will exhibit and describe his: 1. Photographs of sound waves and the kinematographical demonstration of the evolutions of reflected wave-fronts. 2. A new scudoscope. 3. Diffraction colour-photographs. 4. Artificial parhelia.

Saturday, February 24th.—At 7.30 p.m. Manchester Society of Junior Electrical Engineers, at the Deansgate Hotel, Manchester. A paper will be read by Mr. A. Rothwell, Assistant Engineer and Surveyor to the Radcliffe District Council, on "Destructors and their Application to Electric Light and Power Stations," illustrated with lantern, drawings, and model of a modern destructor.

Tuesday, February 27th.—At 8 p.m. Northern Society of Electrical Engineers, Grand Hotel, Manchester. Annual general meeting, presidential address, &c.

Wednesday, February 28th.—At 8 p.m. Society of Arts. Prof. Carus-Wilson on "The Electrical Induction Motor on Mountain Railways."

Saturday, March 3rd.—At 3 o'clock. Royal Institution. Lord Rayleigh delivers the first of a course of six lectures on "Polarised Light."

Tuesday, March 20th.—At 4.30 p.m. Society of Arts (Foreign and Colonial Section). Sir Edward A. Sassoon, Bart., M.P., "Imperial Telegraph Communication."

NOTES.

Rucker v. London Electric Supply Corporation.—The judgment just delivered in the Rucker case by Mr. Justice Farwell is one which will meet with the hearty approval of the electrical engineering industry of this country. Broadly speaking, the idea in granting the protection of a patent is to give the inventor a monopoly for a time, during which he can recoup himself for the cost of his experiments, establish his business, and gain the remuneration which is his due. The inventor is thus stimulated to put forward his best efforts and to spend time and money on the perfection of ideas from which the public must, sooner or later, derive great benefit. There are few people who would wish to see the meritorious inventor deprived of his rights, but the present case need trouble no one under this head for several good reasons. In the first place, at the time the patent was taken the parallel working of everything electrical precluded there being any invention in the broad idea of coupling transformers in parallel. The only work required to make the system useful lay in the devising of apparatus that would work commercially under the circumstances, and the cost and labour of doing this, at any rate in this country, had to be borne by men other than the patentees, who did not in this case do anything for the public, entitling them to protection. In the second place, very late in the day, the patent in question was purchased in this country from the patentees with the view of seeing how far it could be exploited for the collection of royalties, and if the owners had succeeded in holding it, we doubt if it would have much benefited the original alleged inventors. We must, therefore, congratulate the industry upon the decision which has been given, and upon its thus being saved from what might have been a serious expenditure.

The Northern Society of Electrical Engineers.—We understand that as there have only been five nominations on the Council for the five vacancies, there will, this year, be no ballot, the members so nominated having by Rule XXII. become elected on the Council. The list of officers for the ensuing year will be as follows:—

President:
Dr. Edward Hopkinson.

Past Presidents:

Mr. H. Edmunds.	Mr. J. S. Raworth.
Mr. W. P. J. Fawcus.	Mr. S. Z. de Ferranti.
Mr. C. M. Dorman.	

Members of Council:

Mr. Thos. Browett.	Mr. G. W. Lowcock.
Mr. E. A. Claremont.	Mr. A. Marr.
Mr. E. W. Cowan.	Mr. A. B. Mountain.
Mr. H. A. Earle.	Mr. G. H. Nisbett.
Mr. A. H. Gibbings.	Mr. James Taylor.
Mr. J. Slater Lewis.	Mr. C. H. Wordingham.

Hon. Solicitor: Mr. John B. Parkinson.
Hon. Treasurer: Mr. S. V. Clirehugh.
Hon. Secretary: Mr. Samuel Joyce.

(*Continued on page* 278.)

concrete foundations and making up roadway. See "Official Notices" February 9th.

pumps, &c., £1,704, (Section B) pipework, &c., in engine and boiler house, £506; Thames Ironworks Company (Allen) (Section C), two

BROMLEY ELECTRICITY WORKS.

A MORE pleasant situation for an electricity works could hardly be found than that in which the subject of this article is placed—pleasant alike by virtue of its half rural, half urban character, and because of the excellent prospects which it offers from a commercial point of view. The latter feature, by the way, was not appreciated when the original design of the generating station was prepared; the immediate result has been that after little more than 12 months' working the generating plant is being doubled in size, and arrangements are being made for doubling it again!

The Bromley Provisional Order was granted to the District Council in 1891; several gentlemen resident in the neighbourhood, supported by Messrs. Edmundson's Electricity Corporation, Limited, endeavoured to obtain a transfer of the order, and gained their end in 1895. Works were commenced in the spring of 1898, and supply was begun with the permanent plant in November of the same year.

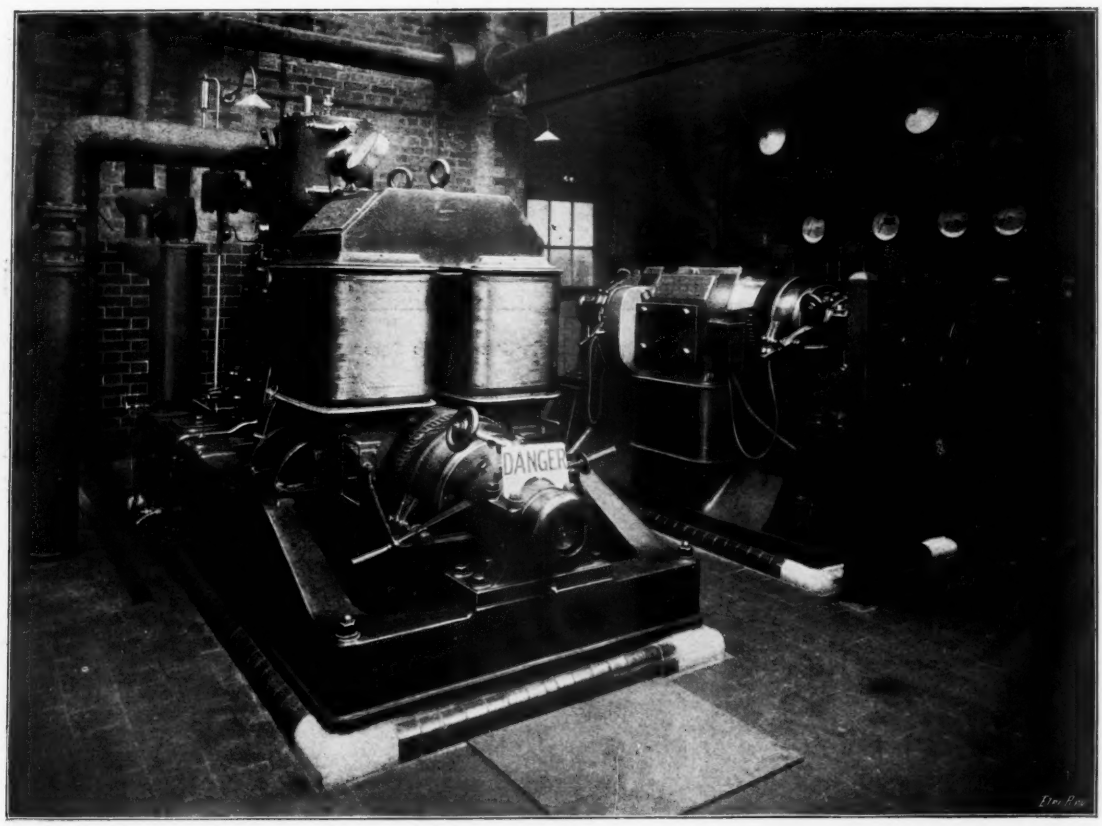
Considerable difficulty was experienced during the erection of the buildings, certain "ancient lights" being met with, owing to which the roof had to be entirely reconstructed. In consequence of this the present engine room presents some inconveniences; for example, the crane cannot be brought over every machine, and the switchboards are in shadow. The buildings include, at present, boiler house, engine room, cell room, and meter room, but considerable additions will be made at an early date. The space available for extension is by no means excessive, but presumably land will be acquired for the purpose.

The boilers are of Messrs. Davey, Paxman & Co.'s well-known "Economic" type, as shown in one of our illustrations; two are at present at work, a third is already in position, and a fourth on order, while three more will be added in the future. Each of these is 14 feet long by 8 feet diameter, with 1,180 square feet heating surface, and is rated at about 250 H.P.; the working pressure is 150 lbs. per square inch. The chimney is 120 feet high, 5 feet in diameter, and is unusually neat and unobtrusive in appearance.

For treating the feed water, which is very hard, a Boby heater detartariser is used, with excellent results; the feed-water is raised to boiling point and consequently freed from the whole of the temporary hardness, while the permanent hardness is reduced by means of soda or Vulite.

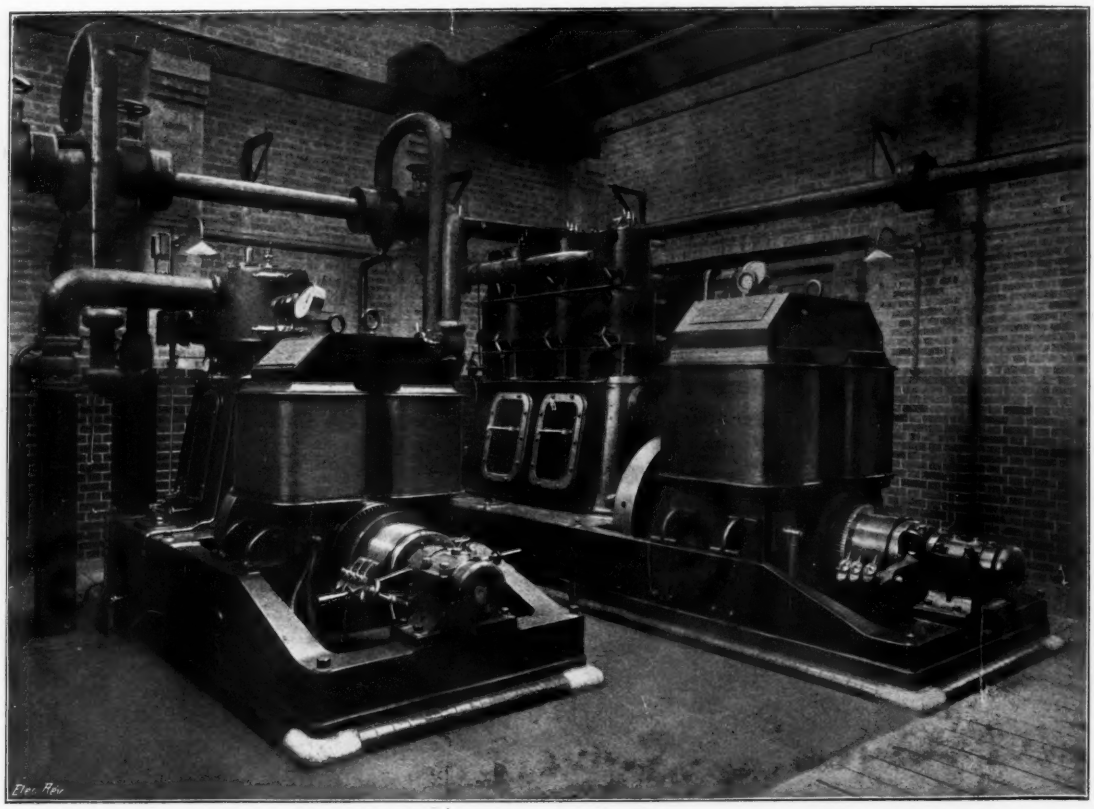
A duplicate set of Worthington feed pumps, each capable of delivering about 12,000 lbs. of water per hour, is at present in use, with duplicate hot and cold feeds.

The steam piping, of mild steel, was erected by Messrs. Babcock & Wilcox, Limited, and consists of a ring main in the engine room, coupled to a header which will eventually form part of a ring main in the boiler house; the pipes are slung from brackets, and are provided with Geipel steam traps and covered with Magnesia non-conducting composition.

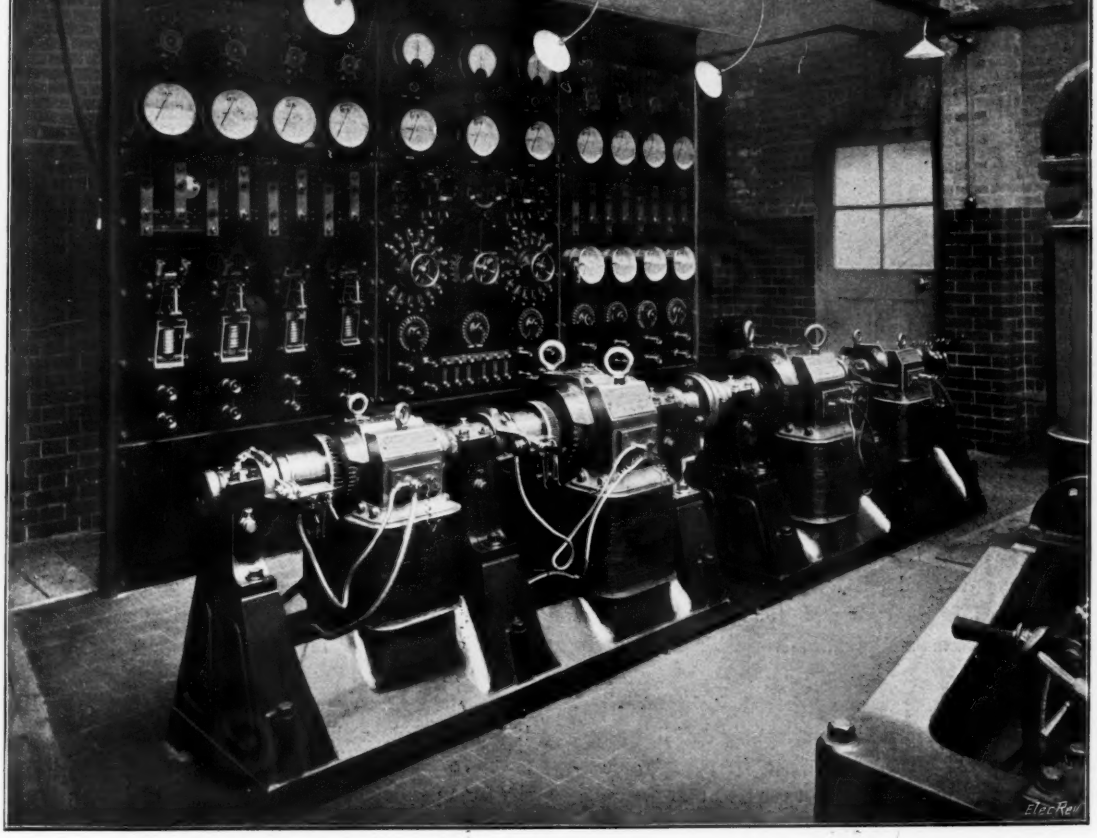


BROMLEY.—HIGH PRESSURE (2,000-VOLT) DYNAMO, TRANSFORMER AND SWITCHBOARD.

G



Bromley.—Low Pressure Generating Sets.

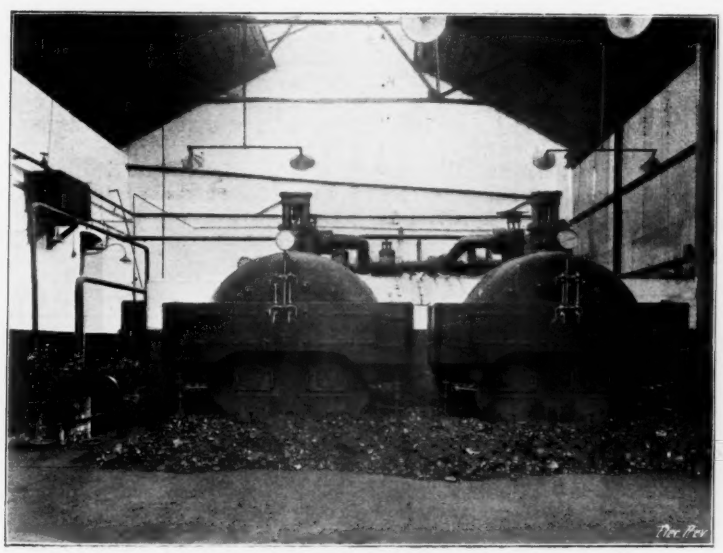


Bromley.—Balancer Booster Set, and Low Pressure Switchboard.

At present the engines exhaust to the atmosphere *viâ* the detartariser, but a surface condenser is to be installed in a pit in the engine room floor, and a cooling tower will be erected on the roof of the boiler house; the detartariser will then be replaced by a feed water heater, heated by the exhaust from the auxiliary engines. Electrically-driven three-throw pumps will also be employed, as well as an oil separator in the exhaust steam pipes and an oil filter in the path of the feed water.

The generating plant is of special interest, since it represents a combination of the high and low pressure direct current systems.

The high pressure machinery shown in one of our views, consists of a Bellis-Parker generating set, a Parker transformer, and a switchboard. The generator is rated at 40 amperes, 2,100 volts, at 420 revolutions per minute, and is of Messrs. Parker's usual type, with Eickemeyer drum-wound armature; indeed, there is remarkably little difference between this machine—which runs at the virtual pressure usually employed for high pressure alternating work—and the low pressure dynamos close by. The field magnets are separately excited from the low pressure bus bars. To facilitate access to the armature, the poles are divided in a horizontal plane through the shaft, the lower halves of the pole pieces being carried in non-magnetic cradles, so that the magnet limbs can be lifted off and the armature exposed with ease.



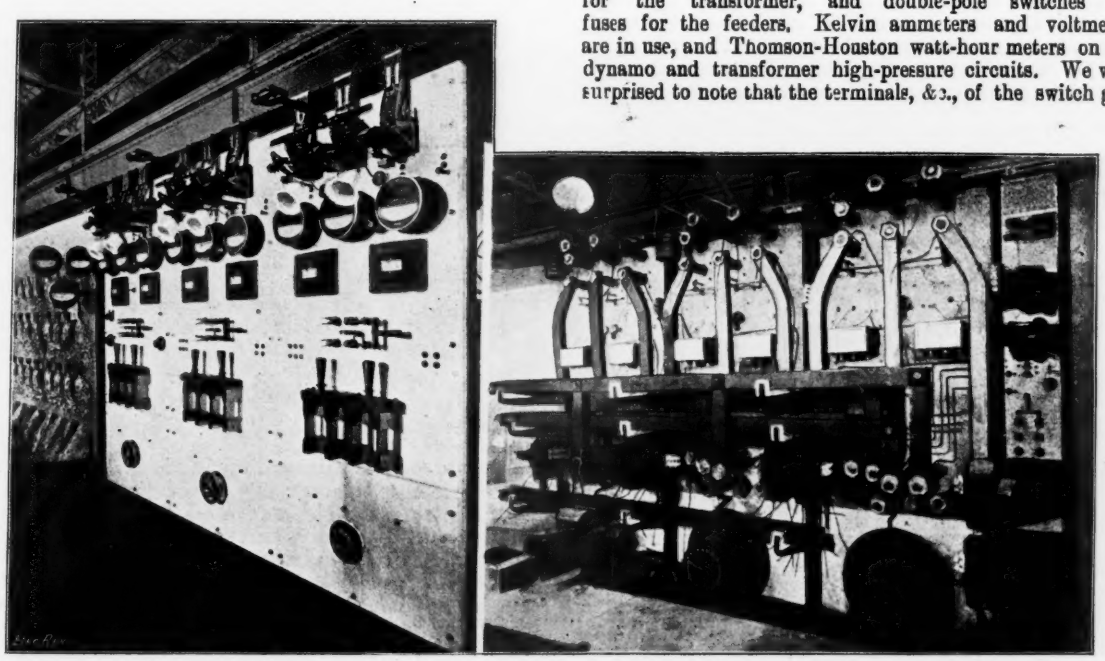
Bromley.—Boilers.

The transformer is wound for 2,000 and 450 volts, 22 and 105 amperes, at 600 revolutions per minute, and is of Messrs. Thos. Parker's upright type, with double wound armature. A special feature of this machine is the device for regulation. Instead of the usual supplementary field magnet, acting on the low-pressure winding only, extensions are bolted to the back of the main pole pieces, and are provided with *de*-exciting coils and pole pieces. The effect of the de-exciting coils is normally to counteract the leakage flux through the supplementary pole pieces; as the load increases, resistance is inserted in the regulating circuit, and the flux allowed to increase so as to maintain the terminal pressure.

The transformer is used to transfer power from one system to the other, or to enable the whole supply to be effected by means of the battery or by running a single generating set of either type at light loads. An additional high pressure generating set is on order; when this arrives, the transformer will be removed to Chislehurst.

The high-pressure switchboard is fitted with Messrs. Thos. Parker's zero and excess-current cut-out, in circuit with the transformer, and zero-current cut-out in circuit with the dynamo, starting gear for the transformer, and double-pole switches and fuses for the feeders. Kelvin ammeters and voltmeters are in use, and Thomson-Houston watt-hour meters on the dynamo and transformer high-pressure circuits. We were surprised to note that the terminals, &c., of the switch gear were mounted direct on the un-enamelled slate, without the use of insulating bushes; this practice, in the case of the low-pressure board, has resulted in the severe corrosion of some of the terminals.

The low-pressure machinery consists of two generating sets, a booster balancer set, battery and main switchboard.



Figs. 4 and 5.—Front and Rear Views of Switchboard, Metropolitan Supply Company, Limited. (See page 277.)

The larger generator gives 410 amperes at 460 volts, 420 revolutions per minute, and is driven by a three-crank engine; a similar set is on order for extensions. The smaller generator is rated at 180 amperes, 450 volts, 420 revolutions per minute, and is driven by a two-crank engine, the dynamos in each case being of Messrs. Thos. Parker's usual type, and the engines of Messrs. Belliss & Morcom's manufacture. The two booster sets are coupled together, the motors which drive them serving for balancers; they are rated at 70 and 230 volts, 70 and 50 amperes, at 950 revolutions per minute.

The 5-ton overhead crane was supplied by Messrs. Isles, Limited, of Stanningley.

The battery consists of 230 23-plate cells of the "D.P." type, capable of discharging at 80 amperes for eight hours or 120 amperes on emergency. The 14 cells on either side of the middle wire are connected with regulating switches on the switchboard, by means of bare copper rods carried on earthenware insulators.

and laid on their solid system by Messrs. Callender; four of these run to a station about three miles away, owned by the Chislehurst Electric Supply Company, Limited, which takes supply in bulk from Bromley. The Chislehurst station, of which Mr. F. S. Hanning is engineer and manager, contains two transformers, a balancer booster set, and a battery, all exactly like those at Bromley, and distributing on the same system. The district is more purely residential than at Bromley, the installations being large and widely scattered; indeed, the large area of low pressure distribution, compared with the number of houses supplied, is probably unique; two consumers, for example, stand almost alone at a distance of 1½ miles from the works! The load factor is also remarkably high. This station, like the Bromley undertaking, was put down by a local company, backed up by Messrs. Edmundson, who have provided the whole of the capital; it has been at work for about nine months, and has at present 4,000 lamps connected. It is interesting to note that the average efficiency of the trans-

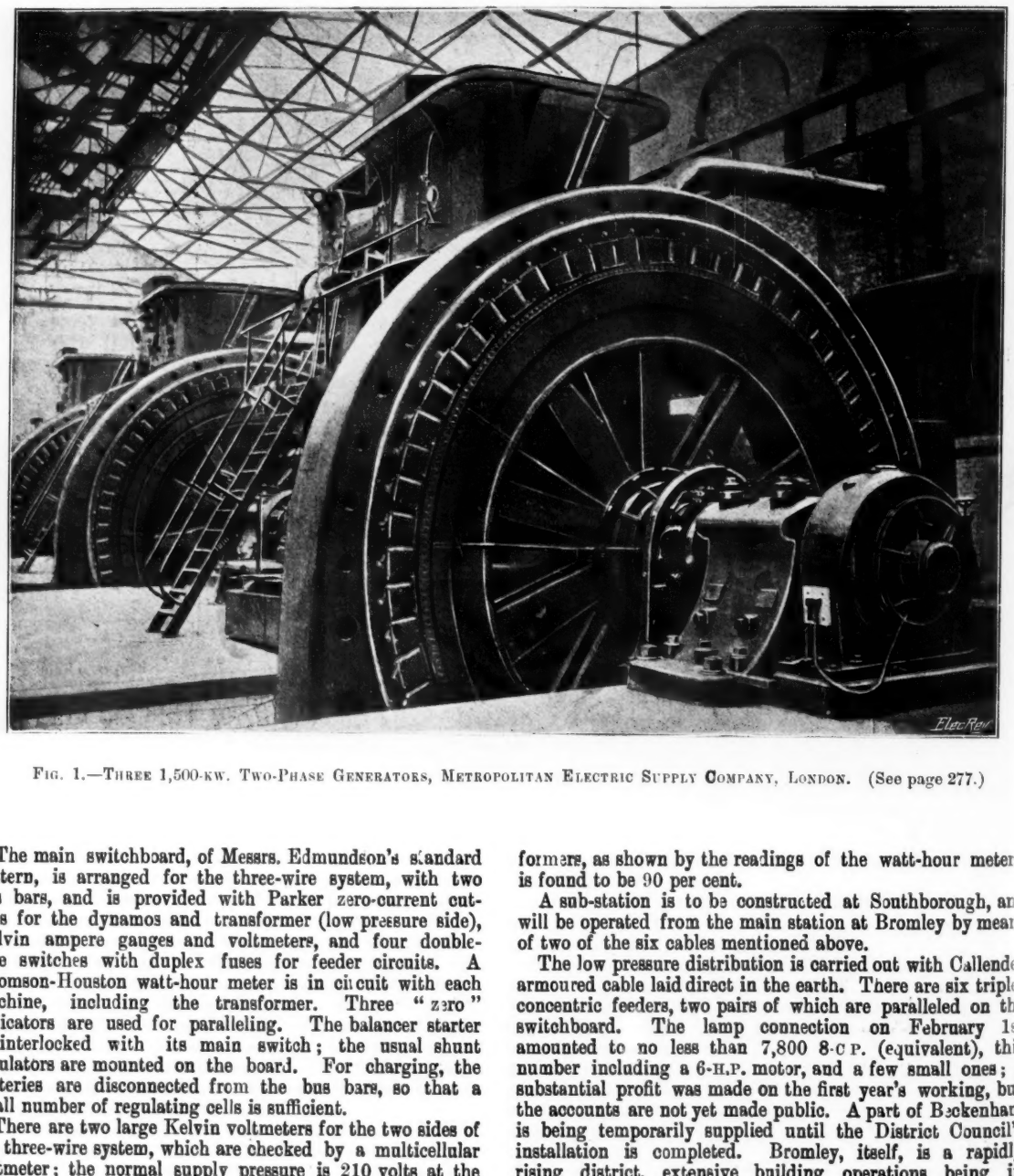


Fig. 1.—Three 1,500-kw. Two-Phase Generators, Metropolitan Electric Supply Company, London. (See page 277.)

The main switchboard, of Messrs. Edmundson's standard pattern, is arranged for the three-wire system, with two bus bars, and is provided with Parker zero-current cut-outs for the dynamos and transformer (low pressure side), Kelvin ampere gauges and voltmeters, and four double-pole switches with duplex fuses for feeder circuits. A Thomson-Houston watt-hour meter is in circuit with each machine, including the transformer. Three "zero" indicators are used for paralleling. The balancer starter is interlocked with its main switch; the usual shunt regulators are mounted on the board. For charging, the batteries are disconnected from the bus bars, so that a small number of regulating cells is sufficient.

There are two large Kelvin voltmeters for the two sides of the three-wire system, which are checked by a multicellular voltmeter; the normal supply pressure is 210 volts at the lamps.

The high pressure feeders consist of six single conductor cables, of 0·05 square inch cross-section, manufactured

formers, as shown by the readings of the watt-hour meters, is found to be 90 per cent.

A sub-station is to be constructed at Southborough, and will be operated from the main station at Bromley by means of two of the six cables mentioned above.

The low pressure distribution is carried out with Callender armoured cable laid direct in the earth. There are six triple-concentric feeders, two pairs of which are paralleled on the switchboard. The lamp connection on February 1st amounted to no less than 7,800 8-c.p. (equivalent), this number including a 6-h.p. motor, and a few small ones; a substantial profit was made on the first year's working, but the accounts are not yet made public. A part of Beckenham is being temporarily supplied until the District Council's installation is completed. Bromley, itself, is a rapidly rising district, extensive building operations being in progress, and it offers golden prospects for the future of the installation—as evidenced by the results already obtained.

No small part of the success realised has been due to the energetic engineer-in-charge, Mr. R. L. Gamlen, and his assistant, Mr. E. R. Hill, who have exerted themselves in every possible way for the popularising of the supply, even to the temporary loss of health through overwork. To these gentlemen we are indebted, and to Messrs. Edmundson's Electricity Corporation, Limited, for their freely accorded assistance in the preparation of the above description.

PLANT OF LONDON METROPOLITAN ELECTRIC SUPPLY COMPANY.

In the Electrical Review for September 23rd, 1898, we gave some particulars and photographs of the alternators being built by the Westinghouse Company, of America, for the Metropolitan Electric Supply Company's new works at Willesden. For those particulars we were indebted to the *Scientific American*. Curiously enough, we have now to turn to another American contemporary for some further information regarding this English electric lighting station, which we understand is now running, and for the following notes and illustrations we are indebted to the New York *Electrical World and Engineer* for February 3rd. It is to be regretted that descriptions of American made plant for works in this country should first make their appearance in American periodicals. In this particular instance, the responsibility, we are informed, does not lie with the manufacturers of the plant.

Two years ago a contract was awarded to the English Westinghouse Company for supplying three two-phase alternators of 2,500 H.P. each for the new power house of the Metropolitan Electric Supply Company, London. This size was then considered an innovation in electric lighting practice, exceeding any constructed up to that time, excepting the 5,000-H.P. generators at Niagara Falls. Since then, it may be remarked, improvements in machinery have enabled far larger generators to be constructed. For instance, the units now being built for the Third Avenue Railway Company, New York, consist of 16 generators of 7,000-H.P. maximum capacity each, with steam engines of corresponding capacity.

Steam Engines.

The three steam engines of 2,500 H.P. each, illustrated in our contemporary's fig. 1, were shown in our issue of September 23rd, 1898. These were built at East Pittsburg, Pa., by the Westinghouse Machine Company, and are of the enclosed vertical compound machine type, with the crankshaft extended at one end to carry the revolving element of the alternator directly upon it. Each of these engines is capable of developing the full rated power of the alternator at 133 revolutions per minute, with 100 lbs. steam pressure. The economical load is secured at 140 lbs. steam pressure and 120 revolutions per minute. As the three alternators are to run in parallel, the angular velocity of the engines is made sufficiently uniform to insure successful parallel running. The cylinders are 36 inches and 55 inches in diameter respectively; the stroke is 36 inches. The cylinders are made of close-grain cast-iron, and as the engines are of the vertical type, the danger of cutting the cylinder castings is reduced to a minimum. Steam is distributed to the high pressure cylinder by a piston valve, and two piston valves serve the low pressure cylinders. The cylinder covers, pistons, &c., are provided with improved means to render their removal easy. The cylinders and steam chests are fitted with automatic water-relief valves and drains, which keep the engines free from condensation. The drain valves are operated from the working platform by levers. Forged steel is used for the crankshafts, which are 14 inches in diameter at the bearings and 20 inches at the armature hub. They are hollow throughout their entire length. The alternator, mounted directly on the engine shaft, serves as a fly-wheel. The engines are fitted with permanent indicating outfits, which are accessible from the main platform, together with an elaborate system of lubrication, a system for cooling the bearings, and provisions for varying the speed while running. All these adjuncts assist in enabling the engines to be run for long periods without stopping. The main bearings, which are cooled by water, are of the quarter-box type, and can be moved in any direction by means of suitable wedges. The main bearings are 14 inches in diameter and 42 inches long. Provision is made to allow the covers to be raised to facilitate inspection.

Sight feed lubricators are used, the oil being carried through brass tubes from the sight feed oilers and manifolds on the cylinders. These are connected to a reservoir on top of the cylinders, which is supplied by a force pump, taking oil from filters. A single inertia governor, which actuates the high pressure valves, controls the engine. The low pressure valves are operated by fixed eccentrics. The governor is keyed to the main shaft and allows an adjustment of 10 per cent. while the engines are running. This permits the speed of the machines to be varied to facilitate operation in parallel. The maximum variation of the governor at any speed within the rated limits is 1 per cent.

Generators.

The three Westinghouse generators shown in fig. 2 are of 1,500-KW. capacity; they are of the two-phase type, generate at 500 volts, and are direct connected to the steam engines. The field consists of a cast-iron frame with 62 pole-pieces, which are built up of a laminated soft steel. The frame is made in halves secured together by bolts. This arrangement allows the halves to be moved back so as to clear the revolving armature. A view of half a field casting is shown in our contemporary's fig. 3 (which appeared in the Electrical Review in September, 1898), together with an armature spider. It gives an excellent idea of the magnitude of this massive machine, with the 62-pole pieces cast into the heavy mass of metal, at accurately spaced intervals.

The field coils are wound with copper strip, bent on edge and thoroughly insulated before bending. The armature spider is constructed of cast iron in halves, with massive rims. The arms of the spider are cast with splitting plates between them to insure freedom from strain in cooling. They are secured in position on the crankshaft by two heavy mild steel rings, shrunk around the bosses at the base of the arms. Each rim is secured by two bolts, and by a shrinkage ring at each joint. The cast-iron arms are supplemented by steel bolts screwed into the boss and secured to the rim by heads, flush with the external surface. The armature conductors are embedded in slots in the periphery of the armature ring.

Steel punchings are mounted on the periphery of the spider, the former being suitably notched to receive the armature conductors, which are large copper bars of rectangular section, heavily insulated and imbedded in the slots. The laminæ on the armature are assembled so as to provide numerous ventilating ducts to enable ample passage of air through the cores and for keeping the temperature of the armature at a low point. The armature is wound with a distributed closed-circuit winding, and the four collector leads draw their current from four equi-distant points on the winding.

Each alternator is capable of delivering at the armature terminals the total output of 3,000 amperes at 500 volts, or 2,727 amperes at 550 volts, divided into two equal two-phase circuits, without the temperature of any part rising more than 33° C. above the surrounding atmosphere. An overload of 25 per cent. can be carried, with the temperature not exceeding 45° C. Three compound multipolar exciters have been provided, which are direct connected to the generator shaft and wound for an exciting current of 100 volts.

Switchboard.

This board controls the three 1,500-KW., 500-volt, 60 p.p.s. two-phase generators running in multiple, and the three 25-KW. 125-volt compound wound direct-current multipolar exciters. The switchboard also controls a storage battery used as an alternate source of excitation. The board comprises three panels of white Italian marble similar in equipment; a description of a single panel will therefore suffice for the whole board.

Fig. 4 shows the front of the board, and fig. 5 the rear. Among the instruments are the following:—

A three-pole 1,500-ampere automatic brush-type circuit breaker; two 2,000-ampere main ammeters, provided with a 5-ampere coil and operated from the 5-ampere secondary of a 2,000 5-ampere series transformer; a 450-ampere direct-current field ammeter; two Niagara type indicating watt-

meters. The series coils of these meters are run in series with the coils of the ammeters noted above, thus necessitating only two series transformers for each panel equipment. One 300-ampere double-throw field switch, which is of the quick-break washer type, and provided with a special attachment for discharging the field of the alternating current generator through a shunt resistance mounted on a bracket at the rear near the top of the switchboard. The switch is made double-throw, so that the generator field may be connected to either source of excitation, the exciter or storage battery. The shunt resistance is connected so as to discharge the field when excited from either source of excitation. This discharging the field through a shunt resistance prevents the possibility of a breakdown in a field insulation, whereas it is subjected to severe strain when the field is opened without this provision. On the lower marble slab are mounted the combination alternating and direct current rheostat hand wheels for the controlling rheostats in the generator fields and exciter fields.

The main alternating current bus bars are built up of 3 inches × $\frac{7}{8}$ inch copper strap, and are mounted on insulated bus bar brackets at about the centre of the rear of the switchboard.

The storage battery exciter bus bars are run at the rear of the board, immediately above the rheostat face plates. To these bars the storage battery leads are connected, and from them the storage battery exciting current is distributed to the field circuit,

In addition to the apparatus specified above for each panel, three voltmeters are mounted on a swinging arm, as follows:—

One alternating machine voltmeter, on which, by means of 6-point voltmeter plug switches on each generator panel, the voltage across either phase of any machine can be read. One alternating current bus bar voltmeter, on which, by means of a 5-point ground detector plug receptacle on "Panel A," the voltage across either phase of the bus bars may be read. One direct voltmeter, on which, by means of 4-point voltmeter plug switches, the exciting voltage on the field of any of the alternating current generators may be read.

NOTES.

(*Continued from page* 272.)

Municipal Telephones—Tunbridge Wells.—At the meeting of the Tunbridge Wells Town Council last week, the Telephone Committee submitted a report recommending that a license be applied for, and in anticipation of the grant of the license, that the Committee be authorised to obtain specifications and tenders for the necessary works. The discussion which ensued, was interesting in several respects. All speakers except one were perfectly satisfied with the canvass, the estimates, the expert's report, and everything else that tended to show the advisability of establishing a municipal telephone service. But the one dissentient voice sufficed at least to induce the Council to "mark time." To Mr. Councillor Robb is due the merit of bringing the Council into such a frame of mind as to limit the first step to the application for a license, and to suspend for the present the recommendation to obtain specifications and tenders. In the course of his speech, Councillor Robb remarked that "the Electrical Review was of opinion that the matter was one of great doubt, and should be approached carefully by municipalities." He criticised the estimates of Mr. Bennett, and was so thorough as not to be merely content with setting aside the expert's figures, but insisted on submitting figures of his own in their place. The difference was somewhat striking. On the one hand, apparently, a profit of £1,000 a year was looked for, and on the other, a loss of £2,000 a year was shown. The value of either of these estimates is doubtful. Both assumed a larger number of subscribers than had yet been obtained. It would be impossible to express an opinion without a complete and careful analysis of the area to be covered, the number of subscribers in respective districts, their distance from the exchange, and the number of exchanges to be served. Regarding the respective estimates, Mr. Robb observed that "he may have overdone it, but the Committee had grievously underdone it." It is quite possible that these few words express the facts of the case, but from the municipal point of view, we are strongly of opinion that Mr. Robb's attitude is right. It is far preferable to count the cost to the utmost than to embark on an important enterprise with too sanguine views.

Electrical Heating of Railway Carriages.—In the system designed by Dr. D. Tommasi, a dynamo driven from an axle of the guard's van sends the current into a circuit extending along the whole length of the train, and on which are branched the conductors connecting the heaters, and traversing them in the direction of their length in the form of a spiral. The heaters are first filled with a substance possessing considerable latent heat of fusion, such as crystallised acetate of sodium, hypo-sulphite of sodium, &c. Before starting for the first time only, the heaters are plunged into boiling water, then placed in the train and connected with the circuit. As long as the train remains stationary no effect is produced, but as soon as the speed is sufficient, the current passes through the heaters. The internal conductors become heated in proportion to their resistance, and the heat thus generated compensates for the heat which is abstracted from the melted substance, *i.e.*, the heat which is lost by radiation, and which serves to heat the carriage. As the heaters can remain active for four hours at least, no stoppage of less duration would produce such a cooling as to make it necessary to replace them. It follows that a train could travel from Calais to Brindisi, or from the Spanish to the Russian frontier, or travel as long as possible on a circle line, or go to and fro between two points, without the heaters having to be changed. We can see at once the advantages that result from this system for both company and passengers—a reduction in the number of heaters required, installations, attendants and repairs, and the suppression of replacing operations, which are so inconvenient and troublesome to passengers, especially during the night. It will be observed, moreover, that the system lends itself to exchanges of plant between the lines on which it is established, since it allows of comparatively long periods of rest, *i.e.*, of interruptions in the compensation of the heat lost.

Personal.—Our New York namesake says that M. André Blondel, the eminent French electrician, whose monumental work on electric railways and in many departments of electrical application has been of so much value, has just been made a Chevalier of the Legion of Honour. The same journal says that Prof. Reginald A. Fessenden, of the electrical engineering department of the Western University of Pennsylvania, has resigned his chair to accept a position in the signal department of the United States Weather Bureau, at Washington.

Lord Kelvin has been nominated for the presidency of the Franco-Scottish Society, in room of the late Marquis of Lothian.

On Friday last Mr. J. S. Highfield, the chief engineer of the St. Helens Corporation lighting and traction station, was presented by the staff with a handsome tantalus as a token of esteem and good wishes on the occasion of his marriage.

Birkbeck Institute Conversazione.—On Saturday evening the students' conversazione of the Birkbeck Institution was held. Mr. Alderman and Sheriff Treloar received the guests. Among the many attractions were a concert, a dramatic entertainment, various exhibits, including liquid air demonstrations, X ray demonstrations by Mr. H. W. Cox, popular lecturettes in the experimental physics and chemical departments, exhibits and experiments in the laboratories, &c. The snowstorm somewhat interfered with the attendance, but there were more than 800 persons present, and needless to remark, the intellectual treats provided, at what must have been a large expenditure of time and energy by the officials, were thoroughly enjoyed.

The Electrical Engineers Volunteers "Send-off" Dinner.—With reference to the send-off dinner to the Electrical Engineers (R.E.) Volunteers ordered for service in South Africa, Mr. Edmunds, the hon. treasurer, informs us that Major R. E. Crompton has arranged that the date for this dinner shall be Saturday, March 3rd, 1900. It will probably be given at the Great Eastern Hotel, Great Eastern Station, Liverpool Street, E.C., at 6.30 p.m., but full particulars will be forwarded together with tickets to entertainers of the corps. It would very much facilitate matters if intending entertainers would send in their names at once.

Wireless Telegraphy.—Mr. Marconi delivered an interesting lecture on this subject at the Royal Institution last Friday week. He dealt with some of the developments which have taken place during the last few months. According to the report in the *Times*:—

He first gave a brief description of his apparatus, laying especial stress on a recent improvement, which consisted of inserting the secondary of a transformer or induction coil in the coherer circuit, the primary being connected with the vertical aerial wire. This induction coil, whose function was to increase the electromotive force of the induced oscillations at the terminals of the coherer, was of peculiar construction. Coils wound in the ordinary way were useless or even detrimental, but the coil he employed had its primary, contrary to the usual custom, wound with fine wire and its secondary with still finer. Moreover, the wire of the latter was not wound in uniform layers, but in a special manner calculated to prevent the effects due to electro-magnetic induction from being in opposition with the electrostatic induction at the ends of the primary. The efficacy of such a coil he tested during the naval manœuvres, and, working between the *Juno* and the *Europa*, he found that while the limit distance attainable without the coil was seven miles, over 60 miles could be obtained with certainty with the coil. As to the distance of signalling, Mr. Marconi said it varied approximately with the square of the height of the vertical wire and the square root of the capacity of the form of capacity-area placed at the top of the wires. With two installations having poles 150 feet high signals were easily obtained at a distance of 85 miles, though according to a rigorous application of the law 72 miles only ought to have been obtained. It was noticeable in this case that, as the two stations were at sea level, there existed between them a hill of water over 1,000 feet high, owing to the curvature of the earth, and if the waves travelled only in straight lines, or if the effect were noticeable only across open space in a direct line, the signals would not have been received except with a vertical wire 1,000 feet high at both stations. The lecturer proceeded to refer to the installations of wireless telegraphy that had been erected between the South Foreland and the East Goodwin light vessel, the South Foreland and Wimereux. But the most interesting and complete tests at sea, he said, were made during the naval manœuvres. The greatest distances at which service messages were sent then were 60 nautical miles between the *Europa* and the *Juno* and the 45 miles between the *Juno* and the *Alexandra*. That was not the *maximum* distance actually traversed, but the distance at which, under all circumstances and conditions, the system could be relied on for certain and regular transmission. During tests messages were sent to the distance of 74 nautical miles. Mr. Marconi next spoke of installations erected at Harwich and Chelmsford, 40 miles apart, which had been working regularly since September last. It was also found possible to signal between these two places and Wimereux. After referring to the use of his system for reporting the yacht race in America and for communicating from the steamer *Paris* when she was 66 nautical miles from land, Mr. Marconi said that six of his assistants had been sent out to South Africa. The War Office intended that the wireless telegraph should only be used at the base and on the railways, but the officers on the spot, realising it could only be of practical use at the front, asked if the assistants were willing to go to the front, and accordingly on December 11th they moved up to De Aar. The results at first were not altogether satisfactory, owing to lack of the poles, kites, or balloons which were essential, but the difficulty was overcome by the manufacture of kites, in which they were assisted by Major Baden-Powell and Captain Kennedy, R.E. It had been reported that the difficulty was due to the iron in the hills, but as a matter of fact iron would have no more destructive effect on these Hertzian waves than any other metal, and he had been able to transmit messages across the high buildings of New York, the upper stories of which were iron. However, when kites were provided it was easy to communicate from De Aar to Orange River—some 70 miles—and now there were stations at Modder River, Enslin, Belmont, Orange River, and De Aar. Two of his assistants volunteered to take instruments through the Boer lines to Kimberley, but the military authorities would not grant them permission, as probably too great risk was involved. It seemed to him regrettable that installations were not established at Ladysmith, Mafeking, and Kimberley before the commencement of hostilities, but he found it hard to believe that the Boers had any workable instruments. Some intended for them, which had been seized at Cape Town, were of German manufacture, and not workable, and Mr. Marconi said that as he had supplied no apparatus to anyone the Boers could not possibly have any of his instruments. In conclusion, he said he did not like to dwell on what might be done in the immediate or distant future. But he was sure that the progress made this year would greatly surpass what had been accomplished during the last 12 months, and, speaking what he believed to be sober sense, he said that by means of wireless telegraphy telegrams would become as common and as much in daily use on the sea as they were at present on the land.

Smoke Nuisance.—At Marylebone on Wednesday the Metropolitan Electric Supply Company, Limited, were fined, including costs, £27 18s., on nine summonses for creating a nuisance by the issue of black smoke from their works at Paddington.

An Automobile "Send-off" for Major Crompton.—A dinner was held at the Automobile Club on Wednesday night in honour of Major R. E. Crompton, a member of the committee of the club, who is about to leave for South Africa in command of a detachment of the Electrical Engineers Volunteer Corps. Major Crompton and the officers and men of the detachment have been incorporated as an arm of the Regular Service. They are taking out to South Africa two trains, both drawn by small traction engines. Each train consists of a tender and store wagon and two light gun-carriages, each bearing an electric searchlight projector and a two-wheeled carriage bearing a drum of electric cable. The purpose of the train is to provide a light and mobile service of electric searchlight for use at the front.

Appointments Vacant.—Two shift engineers are wanted for the Leicester Corporation electricity works during the absence of certain officials in South Africa. A mains superintendent is wanted for Barrow-in-Furness. See "Official Notices" to-day.

The Pembroke District Council wants a resident electrical engineer at £150 per annum. See "Official Notices" to-day.

An assistant is wanted in the electrical engineering department at the City and Guilds Technical College, Exhibition Road. Salary, £150—£200. See "Official Notices" to-day.

Appointments.—The Brush Electrical Engineering Company announce the following appointments:—Mr. C. S. Thomson to be superintending engineer in charge of lighting and power contracts; Mr. E. H. Tyler to be traction engineer in charge of traction contracts; Mr. A. P. Haslam to be in charge of the estimating department.

The Rathmines Council has appointed Mr. George F. Pilditch chief engineer to the new electrical undertaking. From the commencement of the work and up to the time of his appointment, Mr. Pilditch has been superintending the work on behalf of Mr. Robert Hammond, the consulting engineer to the Commissioners.

Fire Insurance Wiring Rules.—We are pleased to note that the Guardian Fire Assurance office has at last officially recognised the electric wiring rules of the Institution of Electrical Engineers. The Guardian prospectus of electrical installation particulars refers to the Institution rules for certain matters, and a few memoranda have been added by Mr. Human for the guidance of wiring contractors. This is a step in the right direction, and Mr. Human is to be congratulated upon his acumen. May it lead to still better things, not only in respect of the Guardian rules, but of those of all other offices.

The Electrical Engineers Volunteers.—It is stated that the sum of £3,000 previously allotted by the War Office for the purchase of plant for the detachment of the Electrical Engineers Volunteer Corps going to the front is to be increased to £5,000.

S. Z. de Ferranti, Limited.—We are informed that Mr. Francis Ince and Mr. Charles Pratt Sparks both resigned their directorships on the board of S. Z. de Ferranti, Limited, on January 30th. These resignations have been duly accepted.

Lectures.—The first of the series of afternoon lectures before the Royal Dublin Society was delivered on 7th inst. by the Right Rev. Monsignor Molloy, D.D., D.Sc., the subject being "Electric Waves and their Application to Wireless Telegraphy."

At a meeting of the Edinburgh Architectural Association last week, Prof. Francis G. Baily, M.A., delivered a lecture on "Electric Light Wiring Systems."

Erratum.—We regret that a slight error crept into our reproduction of Mr. Rosling's letter last week; on page 224, column 2, line 1, for "I am not surprised," read "I am surprised."

HOMES FOR DISCHARGED SOLDIERS.

The Building Trades' Gift.

Electrical Section.

We give below a list of the donations which have been received up to the present towards the electrical equipment of the six homes, for which we gave the detailed specifications in our issue of the 2nd inst. As was there stated, contributions in kind should be forwarded to Mr. Max Byng, of 69, Queen Victoria Street, E.C., and cheques to Messrs. H. Alabaster, Gatehouse & Co., of 4, Ludgate Hill, E.C.

It will be seen that there is ample scope for further contributions, and we confidently anticipate large accessions to the list.

List of Donations to Date.

The Electrical Review £26 5 0

Messrs. E. L. Berry, Harrison & Co., electric light contractors, Whitcomb Street 5 5 0

Messrs. W. J. Furse & Co., Nottingham—Fittings and labour to fit three homes with lightning conductors.

The Newton Electric Engineering Company, Taunton—One 12½-kw. dynamo.

Messrs. Rashleigh, Phipps & Co., Oxford Street, electric contractors—Labour for wiring one home.

Messrs. T. Clarke & Co., Sloane Square, electric contractors—Labour for wiring two homes.

Alley & McLellan, Glasgow—Two 50-h.p. engines at half cost price.

Mr. G. Braulik, Upper Thames Street—Electric light fittings and switches.

The General Electric Company, Limited, Queen Victoria Street—Switchboards, cut-outs, ceiling roses, and switches.

NEW COMPANIES REGISTERED.

Seaside Electric Laundry Company Limited (64,938).—This company was registered on February 3rd, with a capital of £2,000 in £1 shares, to acquire certain freehold land and buildings at Saltburn-by-the-Sea, Yorks, to adopt an agreement with Thomas Dickinson, and to carry on the business of an electric or steam and general laundry. The first subscribers (each with one share) are:—John Gilchrist, Middlesbrough, chartered accountant; Thomas Dickinson, Middlesbrough, contractor; Edward B. Pilkington, West Bridge, Middlesbrough, coal merchant; Henry Glover, 11, Brentnall Street, Middlesbrough, accountant; John G. Kirkwood, 86, Victoria Road, Middlesbrough, solicitor's clerk; Simon F. Thompson, Middlesbrough, solicitor; and Frederick J. Todd, Eaglescliffe, R.S.O., Durham. The number of directors is not to be more than six; the first are Edward B. Pilkington, Harry Hamilton, and Thomas Dickinson; qualification, £25; remuneration as fixed by the company.

Volt Electric Company, Limited (64,943).—This company was registered on February 3rd, with a capital of £3,000 in £1 shares, to enter into an agreement with Arthur Atherley, Thomas W. Hedingham, John T. Leroux, and George W. Holt, and to carry on at Birmingham or elsewhere the business of manufacturers of switches, bell pushes, lampholders, fuseboards, ceiling roses, cut-outs, and electrical fittings and accessories of every description. The first subscribers (each with one share) are:—George W. Holt, 6, Lionel Street, Birmingham, manufacturer; Frank Shaw, 35, Paradise Street, Birmingham, merchant; Edgar A. S. Hooper, 107, Hospital Street, Birmingham, brassfounder; Frank Allbutt, Hill Crest, Clifton Street, Stourbridge, clerk; Percy C. Francis, 337, Balsall Heath Road, Birmingham, solicitor; Alexander O. G. M. Grove, the Delph, Brierley Hill, law student; and Allen Hooper, 278, Corporation Street, Birmingham, leather merchant; registered without articles of association. Registered office, 63, Lionel Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New British Incandescent Electric Lamp Company, Limited (58,316).—This company's annual return was filed on December 24th, 1898, when 23,857 shares were taken up out of a nominal capital of £30,000 in £1 shares; £23,857 has been received.

Southern Electrical Installation and Wiring Company, Limited (63,116).—This company's annual return was filed on December 21st, when 1,853 preference and 3,493 ordinary shares were taken up out of a nominal capital of £10,000 in 2,500 ordinary and 7,500 preference shares of £1 each; 15s. per share has been called on 422 preference and 2,824 ordinary, and £2,399 12s. 6d. has been received, leaving £34 7s. 6d. unpaid. £2,100 is considered paid on 1,431 preference and 669 ordinary.

Pacific and European Telegraph Company, Limited (36,683).—This company's annual return was filed on December 22nd, when the entire capital of £100,000 in £10 shares was taken up. £4 per share has been called, resulting in the receipt of £40,000.

Ryde Electric Light and Power Company, Limited (64,086).—This company's annual return was filed on January 13th, when 7 shares were taken up out of a nominal capital of £10,000 in £5 shares. No calls have been made.

SUPPLY STATION ACCOUNTS.

Edinburgh Corporation Electricity Accounts.

Public and private lighting.

The accounts of the Edinburgh Corporation electric lighting undertaking indicate a continuance of the commercial prosperity which has attracted attention in the Scottish capital as a field for electrical enterprise. Electrical energy is nowhere else sold at the extremely low price of 3½d. per unit for private lighting and 1½d. per unit for motive power, while the charge for public lighting is £14 per annum per arc lamp. The capital charges for a system selling over 4 million units are of interest, and we may give some of the figures as an example:—

Dewar Place station	£136,059
M'Donald Road station	11,816
Mains	202,381
Arc lamps and columns	18,040
Meters	18,810
Transformers	5,215
Instruments...	597

One or two other items bring the total capital expenditure up to £395,357.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£287,466	£395,357	£107,891
Number of units sold ...	2,894,437	4,174,541	1,280,104
Maximum load demanded ...	2,400 kw.	3,116 kw.	716 kw.
Gross revenue	£38,049	£48,238	£10,189
Gross profit	£20,647	£23,730	£3,083
Average price per unit sold...	3·15d.	2·77d.	−·38d.

In the 1897 accounts, private supply is charged at 4d. per unit; motive power at 2d. per unit, and public arc lamps at £16 per annum. The effect of the reductions on the 1898 accounts is to cause a drop of over the third of a penny revenue per unit sold.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£38,008	3·151.	£48,210	2·77d.	−·38d.
Meter rents	...	...	10	...	...
Supply of lamps, &c. ..	...	...	...	...	...
Sundry fees, &c.	41	...	18	...	...
Gross revenue ...	£38,049	3·15d.	£48,238	2·77d.	−·38d.

As might be looked for, the "costs" show an increase of 0·7d. in the item for coal, but all other figures have fallen with the exception of management, which remains stationary. The total costs have according, gone down to just over 1·4d., a reduction of ·03 l. on 1897.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase
Coal	£4,176	·35d.	£7,366	·42d.	+·07d.
Oil, waste, water, and engine room stores.	1,486	·12d.	1,582	·09d.	−·03d.
Salaries and wages incurred in generation and distribution.	4,601	·38 l.	6,491	·37d.	−·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	2,752	·23 l.	3,575	·21d.	−·02d.
Works' costs	£13,015	1·08d.	£19,014	1·09d.	+·01d.
Rent, rates, and taxes ..	1,866	·15d.	2,219	·13d.	−·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,457	·12d.	2,015	·12d.	·00d.
General establishment charges, stationery and printing, law charges and insurance.	1,064	·09d.	1,260	·07d.	−·02d.
Other expenses	...	...	...	...	...
Total costs ...	£17,402	1·44d.	£24,508	1·41d.	−·03d.

The profit statement shows an increase of over £4,000 to cover the interest and sinking fund charges. The net profit in 1897 was £7,024, and in 1898 £5,886, as shown below:—

Profit Statement.

	1897.	1898.
Interest on loans	£5,937	£8,278
Sinking fund for repayments	7,686	9,566
Net profit carried to reserve fund	4,000	...
Net profit carried to credit of rates* ..	3,024	5,886†
Gross profit	£20,647	£23,730

* Transferred to the credit of the burgh assessments under the general improvements ordinary expenditure account.
† Balance at the close of 1898, to be carried to next year's account.

CITY NOTES.

Smithfield Markets Electric Supply Company.

The second ordinary general meeting of this company was held at Winchester House last Friday, Mr. H. S. Leon presiding.

In moving the adoption of the report, the Chairman said that certain circumstances had been very much against the company since it came into existence; circumstances which, to a lesser extent, had been against other companies as well. The light produced by this company's predecessor was certainly unpopular in the markets, and it was difficult for them to regain the custom of the butchers and others. Then they had not had sufficient working capital. There was no provision made for obtaining any except by issuing shares, but as these are quoted below the issue price (£5) they had no power to ask people to take them, and consequently had been short of money necessary to increase the business. They had been handicapped in this way. The board recognised that the value of the stock and business of the company could and should be permanently raised, and this they would endeavour to do by increased customers. There are altogether 408 shops in the market, and on September 30th, 1898, they lighted 188 of them with a candle-power of 9,723. At December 31st, 1899, there were 266 shops lighted with a candle-power of 16,960, leaving 142 not lighted. These they were anxious to obtain as customers. Besides this they had four other large installations, the profit from which they would not be able to ascertain until the end of the current year. The gross revenue for the year ended September 30th, 1898, was £6,501, and the expenditure £5,742, and after paying all interest and other charges there was a net loss of £775; but the gross revenue for the 15 months ended December 31st, 1899, was £12,083, and the expenditure was £8,648, the net profit therefore, after paying all interest and other charges, was £565, reducing the deficit from £775 to £210. Regarding that deficit of £210, he was pleased to tell them that it had been entirely wiped out by the January of this year alone, and there was nearly £100 to the good. That did not represent the monthly profit all through the year, because December and January were the two best months, and the summer months would not be anything like as good. Under the most disadvantageous circumstances they might fairly expect—even after allowing for depreciation—a good net profit at the end of 1900. They expected to save some amount by the accumulators, which were not in working order during the summer months of 1899, but the very high price of coal might wipe off a great deal of the profits or savings thus obtained. The speaker next referred to expenditure on capital account. They were bound to extend in order to make profit, and a good deal of the money they owed to the different firms who undertook the work. Some they paid for out of revenue. They had spent on the accumulators £2,643; on market extensions (mains, &c) £1,830, other mains to outside customers £1,835, and improvements at the generating station £627. This capital expenditure was taken—£1,700 from revenue, and £2,450 was borrowed by the issue of 5 per cent. second mortgage debentures. To make their position perfectly secure, they would like to place £6,000 more of those debentures. Circumstances were continually arising which made it possible to make a judicious expenditure of capital for profitably increasing the business. If that £6,000 were issued, the interest on their debentures was quite covered—even taking the least sanguine view of the situation of the company. Taking the figures for the last 15 months as a basis, he calculated that in the next 12 months the gross revenue would be £9,672, or £806 a month, and the expenses would be £6,912. Add to this £2,422 10s. for interest, and there would be a net profit of over £300. That did not show that the mortgage debentures were particularly well covered, but the next 12 months would be much better. The chief engineer estimated that with coal at the present market price they would have a net profit of about £1,000, but that figure might be too sanguine. Under any circumstances the debentures would be perfectly well covered, and ought to be a fair investment. The position of the shareholders he frankly confessed did not seem to be very hopeful for the next year. Very little had been allowed for reserve during the past history of the company, although they might say that the amount paid out of revenue for improvements was a reserve fund, but a reserve fund would have to be made for depreciation and so forth, and in his estimate for the current year, the engineer had put £1,000 away as reserve. If the shareholders wanted to earn their dividend more quickly, they must take up some of the offered debentures, otherwise they would have to pay out of revenue what certainly should be put to capital account. That was not a bad thing for the company, the profits would enable them to do it, but it would take a long time. The authorised debentures were £25,000, they asked the shareholders to take £12,500 last May, and only £2,450 was subscribed. Now they wanted £6,000 more, and he would bear his share by a thousand or two if others would come forward. They had no Stock Exchange quotation, because certain of the holders of 4 per cent. debentures which were vendors' certificates refused to comply with the rule that they should be so marked. Their light in the markets and elsewhere compared more than favourably with that of other companies, particularly that of their neighbours, the City Company. They had always worked their lights up to the standard, and they had never gone out. In regard to future policy, the board recognised that the interest of the company was wrapped up in the interests of the customers. They were anxious to increase the business in a legitimate way, not by factious competition with their neighbours.

The resolution adopting the report was seconded by Mr. Martin, and, after various questions had been asked and statements made regarding promises which appeared in the prospectus but which had not been fulfilled, it was carried.

Mr. Huggins, in some complimentary references to the chairman, referred to the item of £1,200 spent upon trying to obtain the provisional order for the City. He said that with Mr. Leon as chairman they would not be likely to repeat such a mistake. They were not strong enough to secure the powers.

The election of Mr. Leon was confirmed, and Mr. Schenk was re-elected. (The directors have taken no fees for the year, and they were thanked for this). The auditor was elected, and the meeting closed with the usual courtesies.

The British Insulated Wire Company, Limited.

The directors' report for the year ended December 31st, 1899, to be submitted to the shareholders at Prescot, Lancashire, to-day, February 16th, reads as follows:—"The directors herewith submit the balance-sheet and accounts for the year ended December 31st, 1899. The gross profits for the year amount to £92,653 15s. 5d, from which has to be deducted administration, legal expenses, fees on patents, and interest on debentures, amounting in all to £22,192 19s. 5d., leaving a balance of £70,460 16s. This amount has been charged with depreciation of buildings, plant, and machinery, according to scale, £10,967 12s. 3d.; amount written off patents, £5,000, leaving a balance of £54,473 3s. 9d. Adding to this the balance of £1,994 5s. 11d. brought forward from last year's account and the transfer fees of £90 4s. 6d., there remains a balance available for dividend of £56,557 14s. 2d. The following dividends have already been paid, viz., dividend on preference shares, £10,124 19s. 7d.; and interim dividend for the half-year ending June 30th, 1899, on the ordinary shares at the rate of 10 per cent. per annum, £10,000; leaving a final balance of £36,432 14s. 7d. The directors recommend that a dividend of 15 per cent. on the ordinary shares be declared for the year, which after deducting the interim dividend will leave a balance of 10 per cent. to be now divided. This will absorb £20,000 and leave a balance of £16 432 14s. 7d., out of which the directors recommend that a bonus of 5 per cent. be also paid to the ordinary shareholders, and the balance of £6,432 14s. 7d. carried forward. During the year 12,500 preference shares completing the authorised capital have been offered and subscribed at £6 per share. The buildings of the new copper wire works are completed, and are very nearly equipped with the necessary plant and machinery, and are expected to be working within the next few weeks. This extension will afford greater facilities for the rapid execution of orders. The results of the year's

working have been most satisfactory, and it will be seen that there have been great additions during the year to the purchases and output of the business, the buildings and plant, and the amount of capital employed. Having regard to the greatly increased volume of business in hand and offering, and to the capital required in the copper mills, it is absolutely necessary to provide a large amount of additional working capital, which can at once be profitably employed. Mr. J. B. Atherton and Mr. S. Z. de Ferranti, who are the retiring directors, being eligible, offer themselves for re-election. Messrs. Chalmers, Wade & Co., the auditors, also retire, and offer themselves for re-election."

An extraordinary general meeting to consider the following resolution will be held after the ordinary meeting:—

That the capital of the company be increased to £1,000,000 by the creation of 120,000 new shares of £5 each, and that 60,000 of such new shares shall be ordinary shares, and the remaining 60,000 shall be preference shares, conferring on the holders thereof the right to a fixed cumulative preferential dividend at the rate of £6 per cent. per annum on the capital for the time being paid up on such shares, and such preference shares shall rank, both as regards capital and dividend, *pari passu* with the existing preference shares of the company, but in priority to the other shares, and shall not confer any further right to participation in profits or surplus assets.

St. James' and Pall Mall Electric Light Company.

Mr. Walter Leaf presided at the annual meeting of this company on Tuesday last, at the offices, Carnaby Street, W. After regretting the absence of Mr. Eustace Balfour (chairman) for several reasons, Mr. Leaf said that the last year had been one of rapid growth, the policy of the reduction of the price of current announced last year having fully answered the expectations of the board. In place of the diminution which some more timorous spirits predicted, the revenue showed a growth of £7,723, or 11 per cent. The lamp connections during the year were the equivalent of 21,897 8-c.p. lamps against 16,026 for 1898; 1898 was somewhat below the average, and they might more fairly compare the increase of 1899 with the average increase, for three years, of 17,000. The business was not merely increasing, but it was increasing at an increasing rate. The total lamp connections have now reached 164,750 8-c.p. lamps, and the demand had shown no sign of falling off during the first six weeks of 1900. They must congratulate the engineering staff, and the engineer (Mr. Dobson) in particular, on going without a hitch through a year which had not been free from anxiety. In the face of the state of the coal market it was a remarkable achievement, not merely to have kept up an uninterrupted supply of smokeless Welsh coal, but to have the nominal increase of only $\frac{1}{100}$th of a penny per unit, viz., from 1·95d. to 1·96d. Praise was also due to the office staff under Mr. Walker; for them, too, the year had been exceptionally hard and anxious. Three matters of vital importance had kept them all employed during the year. Firstly, there was their Bill in Parliament for the compulsory acquisition of land adjacent to the station. It was proved to the satisfaction of the Parliamentary Committees that it was necessary that these powers should be granted. Purchase of land under Parliamentary powers was an expensive process. They had had to face it, and any hesitation would have had to be paid for a hundredfold, not merely in money, but in losing the confidence of their customers. They had entered into possession of land, and were leaving no stone unturned for the new buildings to meet next winter's demand. This large extension was absolutely necessary, if they were to meet the demand of their customers. They had a right to expect the cordial support of their customers' representatives on the local authorities with which they had to deal. Those local authorities had very large powers to delay the company in its operations, but delay was very costly, and any want of goodwill could, in the end, only result in loss to the consumers, by putting off the day for further reductions in price. They had had to pass through Parliament a second Bill in conjunction with their neighbours, the Westminster Company, to provide a station outside the parish to meet demands for many years. They had been able to prove their case to the satisfaction of Parliament, and proposed to acquire a site in Marylebone. Negotiations were still in progress, and it would be impolitic to enter into details. They wanted to ensure meeting the demands for many years to come. The issue of new shares went off without a hitch. Since the assets were closed the final instalment had been paid, and there was in hand £75,000 reserve. The new extensions in Marshall Street and Marylebone would require more money in the future to carry them through, and the question of finance would occupy them seriously for some time to come. They were watching the state of the money market, and would only make an issue on terms which would best safeguard the shareholders' interests. Not only were they carrying forward a larger balance than for 1898—which was no more than prudent in view of the present state of things—but they had written off a larger sum for depreciation. That provision of £12,000 was not too large, and they might, he hoped, be able to increase it more in proportion to their capital expenditure in future. It had to cover many things, including the possibility that invention might make it necessary at any time to alter their plant, even though in running order. They had written off two items in their otherwise unassailable accounts, viz., the cost of the artesian well and the three-wire license. This license had expired, and it could not be regarded of any value as an asset. It was proposed to increase the auditors' remuneration from 75 to 150 guineas. The lower figure was fixed when the revenue of the company was less than half what it is at present. They had arranged to pay for six Reservists who had gone from their employ to South Africa half wages to their families, and to reinstate them on their return.

The Chairman moved the adoption of the report, and the declaration of dividend and bonus.

This was seconded by Sir John Morris, and carried unanimously after several questions had been asked and answered.

Mr. Fry said that they had committed themselves to heavy capital expenditure (£52,000) on freehold land; how much did they anticipate it would cost to put up buildings, machinery, &c.? Then, having that large station, was it necessary at the same time to go on with their new stations in the St. John's Wood district?

In reply, the Chairman said with reference to the Great Central Railway arbitration, the railway had the power to hold the money back for nearly another 18 months (July, 1901). The directors never concealed that the loss of that site was an unfortunate affair. They might have two sites on their hands, and with reference to that the engineer said he would be glad if they got both. The increase in the business was so great that they hardly knew how to look forward in regard to the machinery required. Mr. Dobson estimated that the Carnaby Street extension, including land, buildings, and plant, &c., would be from £100,000 to £120,000. That was an approximate estimate.

The retiring directors and auditors having been re-elected, a vote of thanks closed the meeting.

The Bristol Tramways and Carriage Company, Limited.

The directors' report presented to the meeting at the Grand Hotel, Bristol, on Wednesday, reads as follows:—

The directors have pleasure in submitting to the shareholders their report with a statement of the accounts, for the year ending December 31st, 1899. The gross receipts for the year amount to £153,727 19s. 6d., and the working and general expenses and renewals are £103,233 16s., leaving a net revenue of £50,494 3s. 6d. The following amounts have already been distributed, viz.:—

Interim dividend at the rate of *Seven per cent. per annum* (free of income-tax) for the half-year ending June 30th ..			£16,770	16 8
Interest on 4 per cent. mortgage debenture stock, and temporary loans	£5,945	2 0		
Dividend on 4 per cent. preference shares and interest on calls in advance	1,884	13 1		
			7,129	15 1
And it is proposed to appropriate the balance as follows:—				
Dividend for the half-year at the rate of *Eight per cent. per annum* (subject to income-tax)			19,888	6 8
To carry to reserve and renewals funds:—				
Contingencies	£5,000	0 0		
Leased premises redemption	500	0 0		
Electrical renewals	1,000	0 0		
Permanent way renewals	760	5 1		
			7,260	5 1
			£50,494	3 6

With the amounts thus set aside, and interest on investments, the reserve funds will be increased from £80,882 18s. 1d., at which they stood at the corresponding period, to £90,444 11s. 7d., and the company's investments from £75,091 12s. to £87,438 3s. 3d. The receipts from the tramways department show an increase of £7,799, and those of the carriage department an increase of £4,708. The total number of passengers (excluding postal riders) carried during the year on the company's cars and omnibuses was 25,330,806. The important works in connection with the extension and reconstruction of the tramways, and more especially the conversion of the entire system preparatory to electrical working, have continued to engage close attention during the past year, and satisfactory progress has been made in every department. Ten and a half miles of new lines have been laid, and 16½ miles of horse tramways reconstructed with girder rails and copper-bonded, leaving 10 miles of track still requiring to be done to complete the permanent way. The cable conduits have been laid for a length of 10½ miles out of a total of 12½ miles, and the major portion of the requisite street standards and overhead equipment have been erected. The foundations and harbour wall of the central power station having been finished in November last, the erection of the building is now proceeding expeditiously, so that it will very shortly be sufficiently advanced to admit of the installation of the electrical and steam plant. Similar good progress is being shown with the building of the new depôts, those at Brislington and Bedminster approaching completion. All efforts are being generally directed to the introduction of electrical working over the completed undertaking in the course of the ensuing summer. As indicated at the general meeting in February last, the extension to Arno's Vale, and the sections of the system serving Totterdown and the joint railway station in connection with both the tramways centre and Old Market, were converted from horse to electric traction in July last, and have been in successful operation since that time, with results that fully justify the directors' anticipations. The new issue of preference shares sanctioned at the last general meeting was allotted to the shareholders and fully subscribed. It will be seen that the expenditure of capital during the year has amounted to £236,000, and when it is remembered that nearly the whole of this sum is in respect of new works which are for the present unproductive, but that nevertheless the interest and dividend charges are borne by the current revenue, the result of the year's working cannot fail to be gratifying to the shareholders. Mr. William Butler, director, and Mr. Solomon Hare, auditor, retire at the ensuing meeting, and offer themselves for re-election. The dividend warrants will be posted to the shareholders on February 22nd.

Cambridge Electric Supply Company, Limited.

The directors' report to be presented at the ordinary general meeting, to be held at the offices, Thompson's Lane, Cambridge, to-day (Friday) at 12 o'clock noon, reads as follows:—"The directors submit herewith a statement of the income and expenditure for the past year, and the balance-sheet showing the assets and liabilities of the company made up to December 31st last. Your directors have pleasure in reporting that the prospects of the company continue to be satisfactory. During the year 1899 there has been added to the company's mains the equivalent of 3,043 8-c.p. lamps, making the total 28,123. The number of units supplied has been 298,392, an increase of 38,085, or 14 per cent. In spite of the large increase in the price of coal, the cost per unit sold for this item has been reduced by over 8 per cent. To meet the growing demand for elec-

tricity in the town it has been necessary to largely increase the machinery in the engine room as well as the mains and transforming apparatus in the town. A new 500-kw. dynamo and a fourth boiler have been installed, which it is expected will effect some saving in the expense of coal and labour. The capital outlay for the year has been £12,310 6s 2d. The supply mains now extend along 8¾ miles of street. The company, after paying all charges, placing £250 to the reduction of preliminary expenses, £750 to depreciation account, and £150 to the credit of suspense account, has a balance of £3,766 11s. 2d., which, added to £123 11s. 9d. brought forward from last year, makes £3,890 2s. 11d. An interim dividend of £1,176 1s. 10d. and interest on temporary overdraft £68 3s. 5d., have already been paid, leaving a net balance of £2,645 17s. 8d., out of which the directors recommend the payment of a dividend of 4½ per cent., making, with 2½ per cent. already paid, 7 per cent. for the year. This will absorb £2,412 16s. 4d., leaving a balance to carry forward of £233 1s. 4d. The Hon. C. A. Parsons retires by rotation; he is eligible and offers himself for re-election. The auditor, Mr. Arthur Rutter, also offers himself for re-election."

Westminster Electric Supply Corporation, Limited.

The directors' report to be submitted to the annual meeting at Eccleston Place on Wednesday, February 21st, at 11 o'clock, reads:—

"The board of directors have pleasure in presenting their report and the accounts for the year 1899. The supply of current on December 31st, 1898, was provided for the equivalent of 339,986 lamps of 8 c.p. On December 31st, 1899, there were on the books an equivalent of 421,445 lamps. The actual additional lamps applied for and connected during the year was 54,691. The balance of 26,768 lamps represents the results of a re-examination of consumers' connections which has been made during the year, and which showed that the number of lamps connected was, to this extent, in excess of those which had been originally applied for. At the present time there are on circuit the equivalent of 427,322, and applications have been received for a further 8,951 lamps of 8 c.p. The length of roadway in which mains have been laid now exceeds 51 miles, making about 208 miles of ways, into which upwards of 176 miles of copper (strip and cable) have been drawn. Notwithstanding the continued high price of Welsh steam coal, there is again an increase in the net profits for the year owing to the very large number of lamps added during the 12 months, the greatest number in any year since the corporation commenced business. Referring to the change of pressure alluded to in the last report, 99 per cent. of the consumers are now supplied at 200 volts, and the board hope to complete the work during the present year. While these consumers have received a reduction in price, in consideration of the alteration, the corporation cannot obtain any advantage until the entire change has been completed. The Bill for a joint supply station outside the areas of the St. James's and Pall Mall Company and this corporation (acting under the title of the Central Electric Supply Company, Limited), promoted for the purpose of obtaining a central station for supplying energy in bulk to both companies received the Royal Assent in August last. This has become necessary because of the rapid increase of the business of the corporation. Considerable progress has been made in acquiring and developing the site, and building operations will shortly commence. This corporation and the St. James's and Pall Mall Company each hold a half interest in this undertaking. An interim dividend, at the rate of 10 per cent. per annum, for the half-year ending June 30th, 1899, has been distributed. After allowing for depreciation, sinking fund, &c., the net balance available for dividend is £34,668 1s. 6d.; the board, therefore, recommend the payment of a dividend at the rate of 16 per cent. per annum, less income-tax, for the past half-year, making 13 per cent. for the year ending December 31st last, carrying forward a balance of £3,773 8s. 2d. The directors have to record with extreme regret the death, during the past year, of their colleague, Sir Douglas Galton, K.C.B. In accordance with Article 127 of the articles of association, they have elected Captain Bax, late manager of the corporation, to fill the vacancy, and Mr. Hordern, assistant manager, has been appointed manager. In accordance with the articles of association, two of the directors, J. Browne Martin, Esq., and Lord Ampthill retire, but being eligible, offer themselves for re-election."

Waterloo and City Railway Company.

Mr. Wyndham S. Portal took the chair on Thursday, last week, at the twelfth half-yearly meeting of the above company held at Waterloo Station, and, in moving the adoption of the report, said that the expenditure on capital account up to the end of last December was £573,666, and this was out of the authorised capital of £700,000. In the past half-year the expenditure had been £42,521, but this had been reduced by the sum of £35,000 received from the London and South-Western Railway in respect of their surplus properties, and also from the sale of their shunting locomotive to the company. The item for land and compensation, including surveying £270, would not occur in the accounts again. The accounts for the construction of way and stations, including engineering, was not closed yet, and the board had recently to expend about £2,000 in dealing more effectively with the leakage of water. This water did not come from the Thames, but from the soil in which the Waterloo and City stations were built. It was a gravel soil and water bearing. They had been continually pumping ever since the work commenced, but the pumps were only of a temporary character, and now they proposed to put up permanent electric pumps, and the engineers hoped by that means to keep the tunnels free for all water. There was also an item of £648 for electrical equipment, and items of the kind would appear. They estimated that there would be a further expenditure of £40,000 on capital account, but they did not think that sum would be exceeded, and if it was not, they would have constructed the whole line for about £600,000, which was the sum he mentioned a year ago as being the likely sum. The revenue accounts showed that in the past half-year the gross receipts had been £13,000, and the working expenses had been £7,341. The difference in those two sums would not be sufficient to pay a dividend of 3 per cent., and they had therefore to go to the South-Western Company to make up the deficiency of £2,500. That would bring the dividend to 3 per cent. on the ordinary stock, and carry forward £155 to the next account. The work of construction was now practically over, and the directors will hold but few committee meetings, and will accordingly reduce the fees which the shareholders voted to them, and they thought that but fair and right. As they went on the amount which the London and South-Western Railway would have to provide each half-year would grow less and less, until it vanished altogether. That could not be arrived at until the receipts were greater, and their working expenses were less. In the meantime the sum so obtained amounted to £6,300, and it was a liability which the company would have to repay when the difference in the receipts and expenditure were sufficient to pay the 3 per cent. They hoped to do better with that property in the future—they not only hoped so, but they firmly believed so. Already in the past month of January they had received considerably more than in the corresponding month of 1899. A year ago their daily average of receipts was £86, whereas in the past month it was £91, and a daily increase of £5 they considered encouraging. In the past half-year the number of passengers carried was 1,769,731, as compared with 1,442,000 during the five months of the year 1898. The season tickets on December 31st numbered 776, as against 454 on December 31st, 1898. The comparison was not strictly accurate, as they compared six months of 1899 with only five months of 1898, but the gross receipts from August to December, 1898, were £10,800, as against £13,300 for the past six months, which compared again with £13,114 for the first six months of 1899. That encouraged them to expect better things in the future. Three additional entrances had been opened at the City station in connection with the subways of the Central London Railway station, and these gave a more attractive access to the station, and they thought the satisfactory increase in the last month's receipts was largely due to that cause.

Lieut.-Col. the Hon. H. W. Campbell seconded the motion, and it was carried.

The National Telephone Company, Limited.

The directors' report for the half-year ending December 31st, 1899, to be presented to the meeting to be held at the Cannon Street Hotel on Thursday, February 22nd, at 12 o'clock noon, reads:—

"The income accrued in respect of the business of the half-year amounts to £663,523 1s. 11d. as compared with £573,707 3s. 6d. for the corresponding period of 1898, being an increase of £89,815 18s. 5d. The working expenses for the half-year amount to £359,302 14s. 5d. as compared with £312,462 4s. 4d. for the corresponding period of 1898, being an increase of £46,840 10s. 1d. The net result for the half-year (after deducting the Post Office royalties amounting to £64,176 8s.) is a profit balance of £240,043 19s. 6d. as compared with £206,888 6s. 4d. for the corresponding period of 1898, being an increase of £33,155 13s. 2d. The rentals carried forward for unexpired terms of running contracts amount to £631,590 5s. 9d. as compared with £536,654 3s. 4d. at the corresponding period of 1898, or an increase of £94,936 2s. 5d. Out of the available balance of £199,949 16s. 9d. shown by the net revenue account (No. 3) the board will recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares; 5 per cent. per annum, less income-tax, on the third preference shares; and 6 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to tranfer £80,000 to the reserve fund, and to carry forward the balance of £6,199 16s. 9d. The sum of £369,821 19s. 8d. has been expended on capital account during the half-year in the erection of 10,000 additional exchange and private lines, and in the construction of underground lines."

Central London Railway Company.

The directors' report for the half-year ended December 31st, 1899, to be submitted to the meeting to be held in London on 21st inst., states that the expenditure amounted to £325,899, the total to December 31st, 1899, being £3,167,884. £488,165, shown in the accounts as due to the Electric Traction Company, is for work done and plant supplied. The report of the engineers shows that much has been accomplished during the past six months, and the work remaining unfinished is mainly that which could not be commenced until the underground portion was out of hand. The running lines in both tunnels have been laid in concrete, and are practically complete. The whole of the stations are erected up to the first floor. The company does not intend to proceed with the building of the upper stories at present. The booking halls and offices are being fitted up and the walls tiled. The subway at the Bank Station was partially opened on January 8th last. The electric lifts, together with the necessary machinery, are now in position at seven stations, and at the other six stations their construction is proceeding. At the Shepherd's Bush depôt all the boilers and two of the main generating engines have been under steam. The four remaining engines will shortly be completed. All the electric locomotives have been

delivered, and generally the erection of the electric plant has advanced to such a stage that the directors hope an experimental train will be running by the end of this month. A Bill, which will be submitted for the approval of the proprietors at the conclusion of the ordinary general meeting, for the purpose of repealing the original Act relating to workmen's trains and substituting other provisions, will be deposited in Parliament as soon as leave is obtained.

Blackpool and Fleetwood Tramroad Company.

THE half-yearly meeting of shareholders was held in Manchester on 9th inst., Mr. G. Richardson presiding.

The CHAIRMAN, in moving the adoption of the report, said that the undertaking was gradually earning more money, but it was necessarily subject to weather conditions. One thing which was pressing severely upon them was the price of coal, and a contract which they had entered into for 12 months was at an advance of 3s. per ton.

Mr. R. H. PRESTWICH seconded the motion, which, after discussion, was carried.

Prospectus.

DURING the present week the British Electric Traction Company has had in circulation a prospectus of a further issue of £150,000 5 per cent. perpetual debenture stock at £120 per cent. The issue was offered by the Electric and General Investment Company, and the list closed yesterday. The capital previously subscribed was 60,000 £10 ordinary shares, 50,000 6 per cent. cumulative preference (£10), and £200,000 debenture stock.

The Edison and Swan United Electric Light Company, Limited.—The directors have resolved that a payment on account of the dividend of the current year be made at the rate of 6 per cent. per annum, less income-tax, on the "A" shares of the company, in respect of the half-year ended December 31st, 1899. This will work out at 1s. 9⅝d. per share on the partly paid £5 shares, £3 paid, and 2s. 9⅜d. per share on the fully paid £5 shares, less income-tax. The dividend warrants were posted on Wednesday.

Dublin and Lucan Steam Tramway Company.—The directors, in their report for the half-year ended December 31st last, report that the electrical equipment is just about completed. The Board of Trade inspection will take place during this month, and the running of the trains by electricity will very shortly commence.

W. T. Henley's Telegraph Works Company, Limited.—Subject to audit, the dividend on the ordinary shares, payable March 1st, for the past year will be 15 per cent. (less income-tax) including the interim dividend of 4 per cent. paid last September.

Held Over.—Owing to extreme pressure upon our space we are compelled to hold over until next week various matters connected with electrical companies, including reports or meetings of the following:—Portrush and Giants Causeway Railway, Liverpool Overhead Railway (meeting), Scarborough Electric Supply Company, Kensington and Knightsbridge Electric Supply Company, Dublin United Tramways Company, &c.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending February 10th, 1900, were £128 11s. 10d.; receipts for corresponding period, 1899, £143 18s. 8d.; aggregate for half-year to date, £869 11s. 6d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending February 9th, 1900, were £2,362 1s. 9d.; corresponding period, 1899, £2,356 13s. 9d.; increase, £5 8s. 0d.

The City and South London Railway Company.—The receipts for the week ending February 11th, 1900, were £1,149; ditto February 12th, 1899, £1,119; increase, £30. Total receipts for half-year, 1900, to date, £6,789; corresponding period, 1899, £6,771; decrease £82. Miles open, 9½.

The Dover Corporation Tramways.—The receipts for the week ending February 10th, 1900, were £141 1s. 1d.; February 11th, 1899, £141 2s. 1d.; decrease, 1s. Total receipts to date, 1900, £897 6s. 3d.; corresponding period, 1899, £858 0s. 6d.; increase, £44 5s. 7d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,924; 1899, 4,245. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, February 9th, 1900, were as follows:—D. U. T. Co., horse cars, £56 8s. 1d.; ditto, electric cars, £2,644 5s. 7d.; D. S. D. Co., electric cars, £545 0s. 4d.; total, £3,245 14s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £1,771 5s. 3d.; ditto, electric cars, £845 14s. 10d.; D. S. D. Co., electric cars, £584 6s. 4d.; total, £3,201 6s. 5d.; increase, £44 7s. 7d. Aggregate to date, £19,787 12s. 8d.; aggregate to date last year, £18,227 8s. 9d.; increase to date, £1,560 3s. 11d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 16 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending February 11th, 1900, were £446; February 15th, 1899, £340; increase, £106. Number of cars, 1900, 28; 1899, 15. Total receipts to date, 1900, from April 1st, 1899, £26,460; 1899, from June 29th, 1898, £8,802. Miles of track open, 1900, 12; 1899, 6¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending February 11th, 1900, amounted to £1,344; corresponding week last year £1,223; increase, £121; total from January 1st to date, £8,897; corresponding period, 1899, £7,756; increase, £1,141. Miles open, 6·57 chains.

The South Staffordshire Tramways Company.—The receipts for the week ending February 9th, 1900, were £539 12s. 8d.; February 10th, 1899, £533 16s. 7d. Aggregate receipts for 6 weeks, £3,548 14s. 1d.; last year, £3,449 10s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

THE war occupies all men's thoughts in the Stock Exchange just as it does outside, and business keeps as quiet as ever. When in even the mining markets large firms of jobbers confess to booking a mere half-dozen bargains a day, it is not surprising that the more stolid departments should remain quiescent. But to the industrial and commercial markets of the House there seems to be a good deal of attention turning, and some Stock Exchange prophets are predicting that the next upward move in prices will come to these sections. If it does, the electrical supply market should be well to the fore in the revival, prices in most cases having now attained a fairly low level, which might reasonably be improved upon if the money market becomes easier. This latter condition, however, is largely dependent upon the action of the Government in raising the 13 millions sterling which was asked for in the Houses of Parliament last Monday.

Cordial satisfaction is expressed that three of the leading supply companies—the Westminster, Kensington, and Charing Cross—have succeeded in raising their current dividends above those of the corresponding period in 1898. Charing Cross old and new shares are now quoted at same price. The price of Westminsters has dropped 10s., while Notting Hills have added the same amount to their quotation. A good deal of interest centres round the City of London announcement, which has not been made up to the time of writing. As we remarked a week or two ago, the general opinion is that 3 or 4 per cent. will be declared, since it was not until the middle of the company's half-year that the directors reduced the price of the electric current. Chelsea Debenture stock has been wanted by a small buyer. London Electric Supply remain a dull market. The Ordinary have not recovered from their last week's fall, and the Preference at 4¾ show another decline of ¼.

Tramway and kindred shares are showing a little more life, although not to the same extent as in Paris, where new companies for electric tramways in connection with the coming Exposition are being turned out—on paper—every day. British Electric Traction shares are steady, the Ordinary being 16 to 17, and the Preference have recovered the dividend which was deducted from the quotation last Friday. The company has offered its shareholders a new issue of £150,000 5 per cent. first debenture stock at 120, the money being required for electric tramway extension in all directions. We hear whispers that the company is preparing to shortly invade the Continent. By the way, we may mention that a new issue of second Debenture stock by the Buenos Ayres and Belgrano Electric Tramway Company is in contemplation. The scheme is still *in nubibus*, but we should not be greatly astonished to hear of an emission of £120,000 second Debenture stock at 97½. Naturally it will not improve the price of the company's shares for the time being, but on the figures of the last report the Buenos Ayres and Belgrano should be easily able to bear the extra burden. The new capital will, of course, soon become reproductive if the directors' hopes are realised.

In the electrical railway market City and South London Ordinary stock has gained the amount of dividend which came off on February 9th, Waterloo and City achieving the same distinction. For the latter stock there came forward buyers at the end of last week, an impression getting about that the current half-year will see the Waterloo and City Company able to stand more self-reliantly. Considering the way in which coal, wages, and material are increasing in price, we are afraid that the London and South-Western board have not got rid of their bantling's necessities yet. The Central London's report caused no change in the price, but the engineer's hope that by the end of February an experimental train will be running has awakened fresh hopes in holders' breasts. Up to the end of last year the capital expenditure came to over three million pounds sterling. Not until this company gets to work is there likely to be much activity in developing the electrical departments of the two underground lines, although both are now making progress with regard to the new traction power, particularly the Metropolitan District. This company was one of the very few in the home railway list that succeeded in improving its dividend distribution for the latter half of 1899, although, of course, the Ordinary stock got nothing, and under existing circumstances is never likely to do so.

The telegraph market has been mainly noticeable on account of a drop in Anglo-American stocks. To the surprise of the market, a dealer began the other day to offer "old Anglo," *i.e.*, the Ordinary stock, which is not very extensively dealt in as a rule. The weakness, however, is quite natural, having regard to the run upwards of the various stocks before the declaration of the dividend. It frequently happens that excited anticipation of a dividend is followed by a dull time afterwards: this is the inwardness of the drop in Anglo-American issues. Eastern Telegraph descriptions are all a point higher, but "Chinas" do not move. Globe Telegraph and Trust Ordinary, to whose prospects we were directing attention last week, are ½ higher. National Telephone shares are weaker, despite the usual 6 per cent. dividend. The severe weather is entailing heavy expense upon the company for repairs and the like. Manufacturing shares are lifeless.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation, Feb. 7th.	Closing Quotation, Feb. 14th.	Business done during week ended Feb. 14th, 1900.	
			1897.	1898.	1899.			Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	6⅞ — 6⅞	6⅞ — 6⅞ xd	6⅝	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	115 —116	114 —115 xd	116	114½
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	16¾— 17¼	14½— 15 xd	17 5/16	14 13/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	2 5/16	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,332,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103½	103½
234,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	1 %	...	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	9½	9
80,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	101—105%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½— 12	11½— 12	11⅝	11⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	153 —158	154 —159	159	156
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —101	98 —101	100½	99½
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	115 —120	116 —121	119	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	15½— 15¾	15½— 15¾	15⅝	15 5/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	117 —122	115 —120 xd	...	...
17,400	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red., Reg. Nos. 1 to 2,348	100	...	...	...	... ...	... ...	...	...
24,500	Do. do. do. to bearer, 2,344 to 5,500	100	...	...	...	... ...	... ...	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	11 — 11½	11½— 11¾	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½— 16	15½— 16	15 13/16	15⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	...	...	30 — 32	30 — 32	30½	...
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	49 — 53	49 — 53	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	106 —109	106 —109	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	¼— ½	¼— ½	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	6 %	5⅜— 5⅝	5⅜— 5⅝	5 1/16	5⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14 1/16	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 5/16	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	98 —100	98 —100	99½	97½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
8,881	Submarine Cables Trust	Cert.	...	...	...	124 —129	124 —129	125	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	5	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —104	100 —104	...	...
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14⅜— 15⅛	14⅜— 15⅛	15 1/16	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	2½	...	...	⅞— 1⅛	⅞— 1⅛	1 1/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9¼— 9¾	9¼— 9¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	7 — 8	...	...
30,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	...	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	...	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½— 9½	8½—9½	...	...
80,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	10½— 11½	10 — 11	10 1/16	10½
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6⅛	5⅜— 6⅛	5⅜	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	...	7⅞— 8⅛	7⅞— 8⅛	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	...	...	109 —111	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	...	10½— 11½	10½— 11½	10⅝	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 14	13 — 14	13⅜	13⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	...	9½— 10½	9½— 10½	10½	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 — 111	108 —111	111	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅜— 2⅛	1⅜— 2⅛	2	1 13/16
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4⅜— 5⅛	4⅜— 5	4⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	101 —103	101 —103	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	...	14½— 15½	14½— 15½	15½	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	14½	14½
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96½	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	...	15½— 16½	16 — 17	16⅝	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½ %	14½ %	14½ %	15 — 16	15 — 16	16	15½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	14½— 15½	14 — 15	14⅝	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Feb. 7th.	Closing Quotation Feb. 14th.	Business done, week ended Feb. 14th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅜— 3¼	2⅜— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	97 —102	100	9⁵⁄₈
80,000	British Electric Traction	10	...	6 %	...	16 — 17	16 — 17	16⅜	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 13⅝	13½— 13⅝xd	13⅝	13¹¹⁄₁₆
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	...	...
45,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	1⅛— 1³⁄₁₆	1 — 1⅛	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅞— 1	⅞— 1	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	13 — 14	13 — 14	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6½	6 — 6½	6½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞— 2	1⅞— 2	1¹³⁄₁₆	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	...	13½— 14½	13½— 14½	13⅝	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	5⅝
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —115	110 —115	110½	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9½— 10	9½— 10	10	9⅝
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	4⅞	...
71,447	Do. do. Def. do.	5	...	...	...	4½— 5	4½— 5	...	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	59 — 62	58 — 61 xd	59¼	...
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	£5 10s. pd.	10	...	...	...	4 — 5	4 — 5	...	...
32,098	Crompton & Co., Nos. 1 to 32,098		3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.		...	...	...	98 101	98 —101	100	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261		5	6 %	6 %	...	2 — 2½	2 — 2½	2⅜	2³⁄₁₆
17,139	Do. do. do. "A" Shares, 01—017,139		5	6 %	6 %	...	3½— 4½	3½— 4½	4½	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...		100	...	...	...	93 — 95	93 — 95	...	...
112,100	Electric Construction, 1 to 112,100		2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2⁵⁄₁₆	2¼
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...		2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...		Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000		2	...	...	...	⅝— ⅝	⅝— ⅝	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...		10	7 %	7 %	...	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.		5	12 %	14 %	...	13½— 14½	14½	14⅛	14
12,000	Do. do. do. 4½ % Pref.		5	7 %	7 %	...	5½— 6	5½— 6	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...		Stock	4½%	...	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...		10	10 %	10 %	...	21 — 22	21 — 22	21¼	...
800,000	Do. do. do. 4 % 1st Mort. Debs.		100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.		10	3¼%	3¼%	3¾%	9⅜— 9½	9⅜— 9¹¹⁄₁₆	...	...
10,000	† Do. do. Pref., £10 paid		10	5 %	5 %	5 %	13 — 13½	13 — 13½	...	...
87,350	Telegraph Construction and Maintenance		12	15 %	15 %	15 %	37 — 41	37 — 41	39	37¾
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...		100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...		5	...	...	...	9 — 10	9 — 10	...	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...		5	...	...	...	5½— 6	5½— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock		100	...	3 %	3 %	101 —104	101 —104 xd	103	102

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—106.
National Electric Free Wiring, 10s. paid. 5s.—7s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 1½—2½.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½. Debentures, 104—106. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Wednesday, February 14th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£99	£99	..
a „ „	per ton	£27	£27	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %) ..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£24 10	10s. inc.
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£37 10	£37 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb.	3¾ l.	3¾ l.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£85 to £145	£80 to £140	£5 inc.
c Brass (rolled metal 9" to 12") basis	per lb.	8d.	8d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	9d.	..	..
c „ Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed)	per lb.	11½d.	..	..
c „ „ (solid drawn) ..	per lb.	11½d.	..	..
g Copper Bars	per ton	£84	£83	£1 inc.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£84	£83	£1 inc.
g „ Rod	per ton	£84	£83	£1 inc.
c „ (Electrolytic), Bars ..	per ton	£83	..	..
c „ „ Sheet ..	per ton	£89	..	..
c „ „ Rod ..	per ton	£85	..	..
c „ „ H. C. wire	per lb.	9¼d.	..	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
a German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/5½ to 4/6	4/7 to 4/8	1½d. dec.
f Iron, Charcoal Sheets	per ton	£18	£18	..
f „ Pig (Cleveland warrants)	per ton	69/4½	68/8	8½d. inc.
f „ Forgings, according to size	per ton	From £11	From £11	..
f „ Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
f „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 12 6	£16 10	2/6 inc.
g „ „ Sheet	per ton	£18	£18	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 13	£9 13	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d. to 1/	..
f Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £18 to £40	to £40	..
f Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£140 10 to £141 10 nom.	£136 10 nom.	£4 inc.
g „ foil	per lb.	1/9	1/9	..
n „ wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. ..	per lb.	5½d.	5½d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	4d.	4d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Belling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE STANDARDISATION OF ELECTRICAL ENGINEERING PLANT.*

By R Percy Sellon, Member.

To the user of electrical engineering plant, not less than to the producer, the subject of its standardisation is one of great practical importance.

By "standardisation" is meant the general acceptance, to a far greater extent than at present obtains in this country, of certain standards of output, quality, efficiency, or other characteristics of electrical engineering plant, to meet ordinary requirements of usage for light, traction, and power.

1. Of the four chief ingredients of successful competitive production, viz: (*a*) Cheap labour (not to be confounded with low wages); (*b*) Cheap materials; (*c*) Efficient management; and (*d*) Repetition manufacture. Much has been said and written of the first three, but little of the last. And yet every manufacturer of experience knows that it is as influential a factor in determining not only his own profit, but decisive advantages to the user, as any of the factors of labour, materials, or supervision. In order to convince oneself of this, it is only necessary to consider the influence of repetition manufacture upon the price and reliability of any article of common use—say, in our own industry, incandescence lamps and their accessory fittings, in respect of which some measure of standardisation has been evolved; and to reflect what, on the other hand, the cost would be if many manufacturers or users adopted different standards.

In the early years of an industry, experiment and development by trial and error are desirable and inevitable in order to ascertain the possibilities and limitations of the art. But as the stage of repetition public demand is reached, standardisation becomes increasingly possible and advantageous.

Its advance is, however, liable to be retarded by a number of causes, notable among which are the folly of some producers, and the ignorance of many users.

There are always some manufacturers who think that by supplying a special or unique type of apparatus to the buyer they will force him into placing his future orders with them. Hence they resist any tendency towards standardisation.

There are also many buyers who allow themselves to be persuaded into the belief that in securing something new and different from previous usage, they are doing well for themselves and giving evidence of superior intelligence: whereas the probability is that they are paying a higher price for a less reliable article.

There is a third class who believe that standardisation is the business of the producer only; and that the user need not concern himself to assist in bringing about a condition of things for which every manufacturer who knows his business eagerly strives. This view is erroneous.

The intelligent producer is undoubtedly deeply concerned in the advent of standardisation; because it means for him the possibility of repetition manufacture—on the manifold advantages of which it is not necessary to dwell.

But to the user, if he would only realise it, the fruits of standardisation are equally beneficial; for they involve for him the following advantages:—

(*a*) Less capital outlay.
(*b*) Prompt delivery.
(*c*) Immunity from the risks attendant on novel designs.
(*d*) Full manufacturer's guarantees.

2. Viewed from the "patriotic" standpoint, this subject acquires also special significance in these days of acute struggle between British, American, and Continental manufacturers for our own and the world's markets in electrical wares.

The causes which underlie the ability of American and Continental producers to compete keenly and successfully with the British electrical manufacturer are several, and generally outside the scope of this paper. But conspicuous among them is the fact that the former have (as any one who has visited their leading workshops can testify) attained to a degree of repetition manufacture superior to the British producer.

This fact is so noteworthy as to constitute in itself a telling argument in favour of increased standardisation among us; for the flood of American electrical engineering plant into Great Britain is swelling in spite of the fact that we have the advantages of lower wages (on the whole), cheaper materials, and a longer experience of factory organisation.

3. It therefore becomes important to endeavour to trace the cause of this preferential position held by our foreign rivals. The explanation would appear to lie in a difference of procedure.

According to American and Continental practice the producer determines, in a large measure, the character of the plant employed by the user; while according to British custom the buyer very generally imposes upon the manufacturer not merely a specification of the ends he wishes to attain, but the details of means by which he desires those ends to be achieved.

This is due to the fact that under the American and Continental system producers largely secure outlets for their manufactures through the agency of powerful financial organisations created by and allied to their interests, who are concerned simply with commercial results, and are content to leave the technical means of attaining them to the manufacturing interests with whom they co-operate. In America these organisations take the form of collossal Trusts or consolidations of competing interests; on the Continent that of Industrial Banks. In either case there is a close relation between producer and buyer.

In Great Britain, on the other hand, the demand for electrical engineering plant in recent years has issued chiefly from local authorities, or from private users unconnected with any manufacturing interests; and these have very naturally had recourse to electrical engineers acting in a consulting capacity or passing permanently into their service, to guide them in the choice of plant to fulfil their requirements.

That the practical operation of this system in the past has been primarily responsible for the relative absence of standardisation in this country, with its attendant evils alike to user and producer, appears certain. For the user's engineer has frequently been out of touch with manufacturers; and the temptation to strike out on new and "showy" lines, suggestive of individuality, ability or foresight, has, in the very nature of things, been great. The result has been the issue of specifications too often calling for wanton divergencies from previous practice or existing manufacturers' standards.

The source of evil is traceable to the fact that the buyer's engineer has gradually overstepped the rational function of stating the ends or performance required by the buyer, and has proceeded to specify in minute detail the means or constructional methods by which the required results are to be achieved, without taking responsibility for the result.

It is not necessary to adduce specific examples in illustration of this statement, because the author believes that it is one which no fair-minded electrical engineer acquainted with the facts will dispute. There is no difficulty in producing overwhelming evidence of its truth if such be required.

To the same primary cause may probably be traced the variety in size and character of the power units in many of the central stations of Great Britain—another instance of "splendid isolation" in our methods; for foreign practice is at one in adopting fewer and larger units, uniform in size and character from the commencement. Whether advantages of temporarily reduced capital outlay and higher efficiency under our system are a sufficient compensation for loss of interchangeability and periodical relegation of plant to the old metal market, remains to be proved when the bills are presented later on and contrasted with one another. Meantime it is interesting to note that one result of our procedure is the comparative unpreparedness of British manufacturers to compete with foreign producers in the common markets of the world as regards large units.

4. Whether British collectivism is on the whole a more healthy medium than American or Continental private enterprise for the progressive growth of the electrical engineering industry is a large question outside the scope of this paper. We have here to accept it as a fact, and consider whether an evil which has brought in its train is a necessary one; and if not, how it can be averted for the future.

Assuming, then, that the buyer's engineer has come to stay, it would appear that a condition precedent to the standardisation of plant is the standardisation of the buyer's engineer.

The fundamental fact requiring appreciation is that standardisation, to the greatest degree possible, is in the interest of the user at least as much as that of the manufacturer.

From this we may pass on to postulate that standardisation is primarily the function of the producer and not of the user or his engineer, because the former is in a better position to determine, experimentally and by his more intimate knowledge of the means of production, the direction and extent to which it is possible. Inasmuch as the manufacturer's success is dependent on the judgment with which he creates or responds to public demand, there exists always an efficient safeguard that he will not (consciously) standardise on unsuitable or inefficient lines.

The user, on the other hand, is, of course, the proper judge as to the results he wishes to achieve.

It would appear, therefore, that the initial obstacle to a greater measure of standardisation than at present obtains would be removed if the user or his engineer would confine himself to stating the ends he has in view, leaving it to the producer to furnish the means whereby they may be attained.

If this procedure were adopted, users would still retain full liberty of choice between the products of different manufacturers, while the latter would have an opportunity (which under the present system of detailed specifications they do not enjoy) of undertaking repetition manufacture, assuming that they have sufficient confidence in the substantial harmony between their designs and public requirements to take the risk of quantitative production.

This system would have the incidental advantage that the producer could then be properly called upon to guarantee results, since the responsibility of selecting the means to attain them would rest exclusively with him. The present custom too often imposes upon the manufacturer a mass of fantastic detail emanating from the brain of the user or his engineer, for which he is called upon to take responsibility: an illogical system which can only be compared to the proposition that every man should be expected to father another man's child.

It may be objected that the general adoption of the course suggested would lead to stagnation in development, and that the producer, relieved from the constant pressure of change now exerted by the user, would settle down to the perpetuation of antiquated designs—to the disadvantage of the public and the fetich of Progress. The answer to this is, firstly, that much of the change hitherto demanded has been wanton and retrogressive; secondly, that competition within the ranks of manufacturers themselves must always prove a sufficient stimulus to keep abreast of public demand; and finally, that it is largely by the adoption of the system suggested that American and Continental producers are snatching trade from the British manufacturer in his own market.

5. If, then, the principle be accepted that standardisation, with the qualification named, is for the advantage alike of producer and user, we may pass on to consider how far, and by what means, it is capable of beneficial extension.

* Paper read February 8th, 1900.

Standardisation presupposes such a substantial and sufficiently enduring demand for an article as to make it worth the while of manufacturers to incur the requisite outlay in time and money to achieve it. Hence, as already mentioned, in the early and experimental stages of an industry it is neither possible nor desirable. The period at which it becomes practicable is largely one for the judgment of producers. But from the preceding argument it is evident that the user plays an influential part in hastening or retarding its advent—as is proved by the fact that standardisation is much further advanced for the same character of products abroad than in Great Britain. This clearly indicates that it is the system in this country, and not the infancy of the industry, that is responsible for this condition of affairs.

Standardisation, to be enduring, must proceed on lines which shall be beneficial alike to the producer and user. It follows that any attempt to stereotype detail of design or construction must ultimately fail in its object, because such a course will not be adapted to the varying manufacturing facilities of different producers; nor will be acceptable to the user, since it must prove restrictive of constructional improvement and involve the buyer in paying a higher price for an article which the producer will decline to effectively guarantee. In other words, enduring mutual advantage to producer and buyer will only result if standardisation be confined to ends or performance, and not to means or constructional detail.

Under the term "ends" or "performance" as opposed to "means" or "constructional detail" would fall the following:—

(*a*) Steam pressure.
(*b*) Electrical pressure of generation.
(*c*) Electrical pressure of distribution.
(*d*) Periodicity of alternate current generation.
(*e*) Sizes of generating steam units—(say, in convenient fractions or multiples of horse-power or kilowatts).
(*f*) Sizes of mains (say, in convenient fractions or multiples of a square inch or other unit).
(*g*) Sizes of motors;

and similarly as regards transformers, arc and incandescence lamps, and essential fittings and accessories.

That much can be done in this direction is evidenced by the ease and rapidity with which, as regards electric traction, we have acquiesced in the standards of pressure, general construction, and types of motors, trucks, and accessories, prevalent in America. There can be little doubt that had practical electric traction originated with us, instead of being an imported art from the United States, we would still be in the stage in which buyers' engineers would be creating different "standards" of their own composing, while every producer would be expected to manufacture and guarantee a corresponding variety of designs.

The author understands that most of the leading electric cable manufacturers in this country have already adopted, by agreement among themselves, certain standards in their own department of production. The question of standardisation has also for some time received attention at the hands of the Electrical Engineering Plant Manufacturers' Association. Again, the Municipal Electrical Association, a body thoroughly representative of the municipal user's interests, has given evidence of its readiness to co-operate with manufacturers in the direction of standardisation of the commercial conditions of contracts for electrical plant. Its representatives have met in conference representatives of the Electrical Engineering Plant Manufacturers' Association, and have agreed upon certain general conditions as a basis for specifications of plant required by local authorities; and the outcome has undoubtedly been beneficial. It is evident, therefore, that the whole subject is ripe for consideration on the broader basis of harmonising, by adequate representation and discussion, all sections of users' interests with those of producers.

(*To be continued.*)

THE LEGAL STATUS OF AN ELECTRIC INSPECTOR.

1.—Appointment.

The appointment of an electric inspector is provided for by Section 35 of the Schedule 62 and 63 V. c. 19. It rests with the local authority, when they themselves are not the undertakers. If the local authority are undertakers, however, the Board of Trade have power to appoint, and in cases where no inspector is appointed by the local authority, or the inspection of electric lines, &c., is imperfectly attended to by them, the Board of Trade, on application by any consumer or the undertakers themselves, may appoint, and keep appointed, "one or more competent and impartial persons to be electric inspectors under the special order." In all county of London orders the County Council appoint the electric inspectors.

A refusal upon the ground of economy to appoint an inspector in accordance with the provisions of the above section would be met by the appointment of a competent officer by the Board of Trade. It should be noted that the appointment is strictly optional, in the first place, with the local authority, and in the second place, with the Board of Trade.

2.—Duties.

The principal duties of an inspector under the special order are enumerated in Section 36 of Act of 1899. They are:—

(*a*) The inspection and testing, periodically and in special cases, of the undertaker's electric lines and works and the supply of energy given by them (*e.g.*, as provided in Sections 39, 40, and 43–48 *post*).

(*b*) The certifying and examination of meters (*e.g.*, in accordance with the provisions of Sections 50, 51, and 57 *post*).

(*c*) Such other duties in relation to the undertaking as may be required of him under the provisions of the special order or of the Board of Trade Regulations.

Thus by Article (43) of the Board of Trade Regulations under the Electric Lighting Acts, 1882 and 1888 (framed in 1895) the inspector is to some extent at the beck and call of the consumer.

By Section 38 of the schedule to the Act of 1899, after providing that notice of accidents causing loss of life or personal injury shall be sent to the Board of Trade, it is provided in Sub-section (2) that the Board of Trade may, if they deem necessary, appoint any electric inspector or other fit person to make an inquiry as to the cause of any accident affecting the safety of the public. He may also make a report as to the manner in which the regulations and provisions of the Acts and special order have been carried out.

For an instance of such an inquiry, *see* Parliamentary Paper, 1895, No. 55 (City and Euston Road).

Testing and Inspection of Mains, &c.

The duties of an inspector with regard to testing and inspection is laid down in Sections 39 to 48 of the Act of 1899. They may be epitomised as follows:—By Section 39 the inspector is empowered to test mains, after giving due notice of his intention so to do, at such times as will least interfere with the supply of electricity by the undertakers, who are not to be held responsible of any interruption so caused. Such testings are not to be made at any particular part of the lines more than once in three months.

It will be seen that the whole responsibility for any failure in the supply caused by the acts of an inspector is, by this section, taken off the undertakers' shoulders. Inevitable accident or *force majeure* also excuse the undertakers from liability (*see* Section 30, 62, & 63, Vic. c. 19).

On each occasion of the testing of any main or service line the undertakers may, if they think fit, be represented by some officer or other agent, who, however, has no power to interfere with the inspector in the performance of his duties (*see* Section 45). The undertakers are bound, under penalty, to afford the inspector all reasonable facilities for making his investigations (*see* Section 46).

An inspector is bound, by Section 47, to make a report as to the result of his investigations upon the following day, and to deliver the same to the authority or person who have or has employed him. Should they be dissatisfied with the report, an appeal lies to the Board of Trade, who may inquire into and finally decide the matter.

What steps the Board of Trade are likely to take in order to review the inspector's decision are not stated in the Act. Nothing short of a second series of experiments would seem to be sufficient to enable them to determine whether the inspector was right or wrong in his conclusions.

By Section 40 the inspector is required, on payment of the prescribed fee (by a consumer), to test the variation in the current upon any consumer's premises, and make any such other investigation as may be necessary for the purpose of seeing whether the regulations are being carried out.

Right of Entry.

It does not follow from Section 40 that an electric inspector has power to enter upon every consumers' premises unless duly authorised. Thus by Article 42 of the Board of Trade regulations the undertakers may authorise an inspector to enter upon a consumer's premises in order to ascertain whether a leakage exists on the premises, under which circumstances the consumer is bound to give the officer all reasonable facilities for carrying out the work, on pain of having the supply discontinued. The inspector may also, under certain circumstances, in addition to those referred to in the above section, inspect at the request of the consumer.

Thus by Article 43 of the Board of Trade Regulations, under the Electric Lighting Acts 1882 and 1888, framed in 1895, it is provided that if any consumer is dissatisfied with the the action of the undertakers in refusing to give, or in discontinuing, or in not recommencing, the supply of energy to his premises, the wires and fittings of that consumer may, on his application, and on payment of the prescribed fee, be tested for the existence of leakage by an electric inspector.

This regulation must be endorsed on every notice given under the provisions of either of the two last preceding regulations.

Inspection of Meters.

One of the most important duties to be performed by the inspector is that of certifying meters (*see* Section 50). It is provided by Section 51 that an electric inspector on being required to do so by the undertakers or by any consumer and on payment of the necessary fee, shall examine any meter for the purpose of seeing whether it can be certified or not; if so, he is empowered to certify it as fit to be so used.

If any question arises between the undertakers and the consumer as to (1) the condition of the meter, (2) whether the value of the current has been properly registered, the difference is to be settled by the inspector, or if the local authority are undertakers by the inspector appointed by the Board of Trade. At the hearing the inspector, whose decision is final, has power to award costs to the successful party.

"Subject, as aforesaid, the register of the meter shall be conclusive evidence, in the absence of fraud, of the value of the supply."

3.—Remuneration.

Where the inspector is appointed by the local authority his remuneration is fixed and paid by them, Section 37 (1), the exact amount to be determined between the parties to the contract; it may be in addition to, or in substitution for, any fees which are directed to be paid under the special order or Board of Trade Regulations. If,

however, the local authority are undertakers, the Board of Trade appoint the inspector and fix his salary, Section 37 (2).

In the absence of agreement, or special provisions in the order of the Board of Trade Regulations, it is provided, by Section 48, that the fees and reasonable expenses of the inspector shall be ascertained by a court of summary jurisdiction, or by the Board of Trade, where the inspector is appointed by them. If the local authority are undertakers, fees, &c., are recoverable summarily as civil debts; but in certain cases the consumers themselves may become liable to pay the inspector's fees.

TECHNICAL EDUCATION IN AMERICA.

One of the best articles on technical education ever penned appears in the *American Machinist*. It is written by F. A. Halsey, and is entitled the "Engineering Education of Mechanics." It is realised in America that what we have often pointed out regarding the disastrous results of multiple production upon the workers is true, and one American writer cannot see whence are to come the shop managers and foremen who have come to the front under past and gone conditions.

Mr. Halsey insists that, despite a certain amount of success achieved by the technical schools, they are based on a false foundation. In their earlier days a certain proportion of boys from the shops did succeed in scaling the fence which had been built to keep them out—the fence being the entrance examination. At that time the fence was moderate in height, but it has been successively raised higher and higher, and now it is practically impossible for any but the high school boy to top it.

The American high school, we take it, is the equivalent of our higher grade Board Schools, a sort of continuation school for the nimbler minds. Yet in those old days the few shop boys were the leaven of the technical school, for they were more or less versed in shop methods.

Mr. Halsey claims that boys who have served an apprenticeship should be admitted to the technical schools alongside of the boys from the high schools, who alone can now find entrance over the fence; the shop work of the one being allowed as the equivalent of the school work of the other. One objection urged is that such a course will cause confusion. No doubt it might cause some necessary reorganisation, and would be a trouble to the professors, whose pedantry would be hurt.

Another objection is that the technical school claims to be on a University grade, and could not be expected to teach the primaries in algebra, and even in common or garden arithmetic.

That these ideas do prevail we are aware. Mr. Halsey has a ready reply to such flimsy arguments. He points out that it is equally *infra dig* for a school on a university grade to teach such primaries in mechanical shop work as are exemplified in turning spools and paper weights, and yet it is such useless trivialities that are taught to the fresh boys from the high schools who may be mathematical but are not mechanics. It is, says the author, equally necessary that the school should teach the shop boy his simple algebra, as that it should teach the more lettered boy the first rudiments of machine work. The fact is, the technical schools aim to start too high on one side of education, and they thereby shut out boys whose shop knowledge, experience, and skill would be well worth the trouble of the high school boys to acquire in return for the help that in their turn they could give to the shop-trained boys. The author proceeds to condemn the examination test of entrance as entirely out of relation to a boy's mechanical ability or taste, and he complains that the engineering schools of the country have all been modelled after one another, and are altogether too much surrounded by the academic atmosphere for any change to be expected from them. Mr. Halsey would aim at teaching mechanics rather than teaching shop work to collegians, and there is very much to say on this score.

We do not think the same stiffness of entrance examination obtains in regard to English schools. Indeed, it has been held that our English boys could not possibly enter a Swiss or German technical school, because the entrance examinations there are much too advanced, and that this is so we fully believe, after seeing the prospectus of the Polytechnic at Zurich and other places. What Mr. Halsey would like to see attempted would be a technical school which aimed at being self-supporting—which should endeavour to produce saleable articles.

We suppose it would not refuse paying students, but it would receive as students youths who, having acquired some skill in actual shops, should be paid to work at the school shops. In this way certain students unable to pay all or any fees might be partially or wholly self-supporting by the work they would perform. It would never pay financially for a boy to work in the college shops. The sole inducement would be the further education he would acquire. But the teachers would need to be good practical men, capable of earning good salaries in actual shops, and only tempted from them by good pay at college. We feel that Mr. Halsey has somehow got a sound grip of the question, and we cannot but believe that for the technical teaching of mechanical work the academic idea has been far too prominent.

Nine out of 10 students probably are quite unfitted to take positions as engineers, to distinguish from a mechanic a man who should possess some knowledge of how to apply the laws of chemistry and physics and be capable of understanding arguments based on such sciences. Machine tool work, for example—a branch of work which Americans have developed to a greater extent than any other nation—is not one that demands for its successful pursuit a specially wide knowledge or a scientific knowledge. But it does demand a very peculiar and special kind of knowledge of the properties of iron and steel along a certain narrow groove, and it demands a knowledge of shop systems and of a peculiar class of men. We would, however, not urge too severely narrow a training for any line of work, but we would not demand too wide a knowledge or too deep a knowledge in an entrance examination. Narrowness has, of course, its peculiar evil effects. The narrowness of the American school of machine tool makers is already having certain ill effects upon American productions. We refer to the demand of American tool makers for kindly materials—a demand legitimate enough up to a given extent, and one that we might ourselves more fully acknowledge and meet, but in America the demands of the tool men have gone too far, because these men could see only one thing in front of them—rapid production—and all American stuff suffers in that it is apt to be soft where it should be hard, yielding where it should stand stiff. The *American Machinist* itself is beginning to recognise this weakness. It is, at least, an argument against narrowness of thought and training.

ON THE THEORY AND PRACTICE OF GETTING JOBS.*

By J. W. ALVORD, M.Am.S.C.E.

In recently looking over a mass of pamphlets in one of our society libraries, I became impressed with the lack of attention to the very practical subject which I have chosen as the title of this paper. It is a cause for congratulation to note the completeness and care with which professional brethren have been willing to lay before us, in all possible detail, the methods that they have adopted, the researches that they have made, and the conclusions at which they have arrived after long and laborious study in the performance of jobs which they have already secured; but when it comes to the important and interesting problem, how to obtain such jobs, these writers are usually more than modest, and if, perchance, they hint at that phase of the subject at all, it is with the lightest and airiest touch, or the breathing of some such unsatisfying and elusive ritual as: "The committee having placed the matter in my charge," or "being consulted by the president of the company," or that still more common and unsatisfactory expression, "The writer being called in at this juncture to undertake the work," &c.

I have enjoyed reading such phrases as these for many years. They appeal to my imagination. In my mind's eye I could see a committee of solid and influential citizens, after long and profound consultation, coming to my professional brother's office in a body and solemnly—one might almost say reverently—"placing" the matter in his charge, unreservedly and fully, and with a simple and childlike confidence that in so doing they had fully ensured the brilliant success of the proposed undertaking.

In the course of years of expectancy and yearning for jobs—and more of them—such delightful experiences as these have been somewhat few in my own career, and when the remotest similarity to the examples given have actually occurred, the experience has left me in a stunned condition of mind. In earlier years I naturally felt with humility that I was only clinging to the outskirts of the profession, hanging on to its extremities, as it were, and when I lost my first important salary and tried to get another, I felt a good deal as a cat does when it is thrown out of the upper window, and goes down with a rush, clawing, yowling, and grabbing at everything in sight, in a vain attempt to ease the situation. My inability, at that time, to get my claws into anything tangible made a serious impression on me, which has only deepened with the lapse of time and the accumulation of experience.

At this particular point I desire to contrast the theory of getting jobs with the practice thereof. You open an office and insert your business card in the technical papers. Then you brace yourself for the flood of business. Your professional rivals drop in one by one to ask "how it comes on," and incidentally to see how much your office furniture cost you, and otherwise assure themselves that you are not remotely likely, as yet, to get a job away from them. A few book agents vary the monotony of life, and once in a while a well-dressed life insurance agent makes your heart jump into your mouth as you lead him into the inner office with every nerve braced to keep the joy out of your face, as you try to assume a bored and indifferent air. I know of few more soul-wrenching moments than the one that comes when the life insurance man discloses his business in that inner sanctum. It is for this, then, that those pumping engine details have been scattered over the table, and books on deep and abstruse subjects placed where they meet his eye! A man who can pass through these experiences without the freshness of his hope being perceptibly withered, has fitted himself for a better land.

But yet the theory seems to be all right. You are a professional man. Your work is such as to require confidence in you on the part of your clients. Consequently, it is indelicate on your part to push your claims to their notice. You feel competent to do their work. You have done it before, over and over again, successfully; but you must not intrude this fact upon their notice, but must wait for them to come to you.

These are the conclusions I have been led to, at any rate, after long

* Abstract of a paper read before the fourteenth annual meeting of the Illinois Society of Engineers and Surveyors. From the *Railroad Gazette*.

years of perusal of engineering literature. I take delight in the theory. It accords with my own sensitive nature and my retiring disposition. I always read articles on the "Standing of the Engineer," and "Ethics of the Profession;" I am especially fond, too, of "Presidents' Annual Addresses." I consider them delightful reading. I well remember returning, seven years ago, from a $75 trip to Braceville (where I had been at my own expense, to see another engineer receive a job), being much comforted by reading the annual address of our worthy president. It seemed to relax the strain of the Braceville episode to read of the great achievements of the engineer along the different lines of his profession throughout the world, and to know once more that his was the opportunity to "harness the forces of nature to the uses of man." I have been familiar with that sentiment for many years, but it never seemed to have the same weight and swing as it did on this occasion. It calmed my nerves and filled me with a glow of hopefulness. I felt once more a man. I think we cannot set too great a store on these presidents' addresses.

It may be inferred from my reference to the Braceville episode that I have sometimes gone out after jobs. It is with some reluctance that I am compelled to admit here, confidentially, that once or twice I have "run over" to a town or two, to see if there was any interesting and instructive work going on. I very well remember the first time I did this. I thought it a little singular that I should find, near the bait, the plain foot-prints of several distinguished professional brethren versed in that particular specialty. Some of them, I was told, had "stopped over" on their way to important work at other points further on. Some had been invited by a particular friend, who was extremely anxious to see the important work in the proper hands. Nearly all fortunately happened to have with them some copies of testimonials of former work, which they would leave. The engineering of this particular job was finally let on proposals. I remember that at the letting several of us who happened to be in town were interviewed by the council one by one behind closed doors—sized up, so to speak. I also remember, while waiting for my turn to trot, being called aside by a mysterious man with a wandering eye and a sinister smile, and being informed in a highly secretive manner that the firm of Tripod and Sight-pole had secured three of the council, and that there would be no show for me unless I would leave the matter with him—that he had a good deal of influence with the council, and wanted to see me get that work. I remember being much touched by his sympathy and solicitude on my behalf, and saying to him earnestly that if awarded the work I would endeavour to do it well and faithfully, together with much more in the same strain, and net results of which, much to my surprise, seemed to cool his interest wonderfully. I noticed afterward that Messrs. Tripod and Sight-pole got the work, and I remember particularly being struck with the fact that there was a difference of some 3,000 per cent. between the highest and lowest bids. It is natural to abuse the wily council-man for his lack of appreciation of engineering ability, but it is hard to see how he can form a very high opinion of a profession whose members have such a variable estimate of themselves.

After my arrival home, I watched eagerly for next week's technical papers. Now, thought I, we will have this disgraceful competition exposed by an able editorial on "the folly of treating brains as merchandise," or "low depths of ignominy to which some town councils are sunk." I was disappointed. After searching vainly all through the news column, I found the following brief item in the next issue: "The services of Messrs. Tripod and Sight-pole, the well-known engineers of Metropolisville, have been secured by the city of," &c., &c.

After this, my confidence in the theory of getting jobs began to wane. I laid the theory on the shelf, as it were, and found myself compelled by urgent necessity to discover the practice. In the course of a number of years of heartrending experiences I have, I think, discovered a few simple rules for getting jobs which, after much reluctance, I have concluded to give to the profession in absolute confidence. They have not always worked as well as I would like, but they at least give one a fair chance with other professional brothers, and they are as follows:—

1. Find your job. This is quite necessary. I have completely discarded the theory on which I started in, that your job should find you. It may work once in a while, but as a rule a needy engineer out of work is a great deal keener hunter than a lonesome job is. After you have found jobs for a good many years, it is possible that some stray jobs may find you; but I wouldn't count on it.

2. Know a great deal more about how that job ought to be done than anybody else around. There is no doubt at all but that this is a very important requirement indeed in the practice of getting jobs, but it is one which I feel almost ashamed to mention, and indeed would have forborne to speak of, had it not been that occasionally I have met enthusiastic and confident engineers eager and willing to lend a hand in the great work of harnessing the forces of nature, but a little uncertain as to the difference between the breeching and bellyband. This delightful trait of ambition in our profession should be commended, could it only be turned into proper channels.

3. Know the men who have the jobs to give. This last rule seems also to be one of those delightfully simple propositions, in theory, which are found so difficult in practice. The theory of the thing is that an engineer's reputation ought to precede him everywhere. In practice he is usually exceedingly glad if it will only follow him at a respectable distance.

People with jobs to give want to see you, poke your ribs, and put you through your paces, as I have elsewhere intimated. And if you would like to be their "hired man," it is best for you to go and submit yourself to the process as gracefully as you can. I believe, however, that it is quite possible to do all this and still be modest. There is no money in being bashful, but to be suitably modest, at the proper time and in the proper amount, is an art whose worth to the fortunate possessor cannot be over-estimated. Long years of harrowing experiences have frayed the edges and removed the bloom from my own early attempts to be modest. Yet I cannot refrain from referring with pride to one attempt which may prove instructive. In the first year of my apprenticeship the city directory man called at the office in which I was engaged, and asked for my name and designation. Naturally, I did not feel at that time that I stood more than upon the threshold of our great and noble profession, so I informed him simply that I thought I might be entitled to be called an "engineer's assistant." I am at a loss to determine, even to this day, whether this was an act of true modesty or mere bashfulness, but the classifier at the central office of that directory had evidently no difficulty whatever in placing me. He had met pretentious people before in his line of business, and when the directory was duly printed and issued, I was dumbfounded to observe the appellation of "fireman" following my name and address.

It is pretty evident that the business world makes but little allowance for ordinary modesty, but it doubtless has distinct difficulty of its own in designating and classifying a profession which expects a man to drive stakes in a sewer, or paint landscapes in the office, or corner the elusive bacillus in the laboratory, or throw off a literary gem in the shape of a financial prospectus between meals.

PHYSICAL SOCIETY.

Annual General Meeting held February 9th.

Prof. Lodge, F.R.S., President, in the Chair.

The following officers were elected to form the Council:—

President.—Prof. Lodge.

Vice-Presidents (who have filled the office of president).—Dr. Gladstone, Prof. Carey-Foster, Prof. Adams, Lord Kelvin, Prof. Clifton, Prof. Reinold, Prof. Ayrton, Prof. Fitzgerald, Prof. Rucker, Sir W. Abney, Mr. Shelford Bidwell.

Vice-Presidents.—Mr. Blakesley, Mr. Boys, Prof. Everett, Mr. Griffith.

Secretaries.—Messrs. H. M. Elder and W. Watson.

Foreign Secretary.—Prof. S. P. Thompson.

Librarian.—Mr. W. Watson.

Treasurer.—Prof. Callendar.

Other members of Council.—Prof. Armstrong, Dr. Atkinson, Mr. W. Bailey, Prof. Glazebrook, Mr. E. H. Griffiths, Mr. S. Lupton, Prof. Perry, Mr. Swinburne, Prof. Threlfall, and Mr. J. Walker.

Mr. Addenbrooke asked if the Proceedings of the Society could be published with less delay.

The Chairman promised to try and have them printed sooner.

Prof. Lodge then delivered his presidential address on "The Controversy Concerning Volta's Contact Force." Those who take a metallic view of the Volta contact force are accustomed to deny that the Peltier evolution of heat measures the local E.M.F. existing at a junction. They assert that it measures the rate at which that same E.M.F. varies with temperature. In the thermo-dynamic equation connecting the Peltier effect with the variation of E with temperature, the E which varies is not necessarily that at the junction considered, but is the total E.M.F. of the circuit. The reversible heat at a specified junction is a measure of the metallic E.M.F. located there. Those who say it is a temperature variation of the E.M.F. beg the question by locating the whole E.M.F. of the circuit at the particular junction they are considering, usually an interface of zinc and copper. At a chemical junction the E.M.F. is not purely thermal, and hence is not measured by the Peltier effect; it is chiefly of chemical origin, and is calculable from the energy of combination of the materials on either side of the boundary. At a metallic junction there is no such chemical potentiality. A strong current may be passed across a zinc-copper junction for years, and no brass is formed. It is therefore improbable that the chemical affinity of zinc for copper is the propelling influence which causes the E.M.F. located at such a junction. In showing the Volta effect experimentally, a trace of liquid can act detrimentally by forming a conducting bridge between the plates, across which the bulk of the electricity passes as the metals are being separated. The safest and clearest mode of expressing the Volta effect is that it consists in an opposite charge acquired by dry zinc and copper, while in metallic contact, a charge which results from an E.M.F. of fixed value, and is controlled solely by this E.M.F. and electrostatic capacity. It is undeniable that the order of the Volta force can be calculated from the differential heats of combination of the metals for oxygen, although it is doubtful whether it can be calculated from the heat of formation of brass. The opposing sides of the old controversy used to be called contact theorists and chemical theorists. Now the opposite sides are involved both in contact and both in chemical views. It is a question of which of several contacts is the effective one, and what kind of chemical action or affinity is the active cause. Is it the contact and chemical affinity across the metal junctions or across the metal air junctions? The opposite sides are thus metallic and dielectric. The metal air force is of the order volts, the metal force is of the order milli-volts.

When a piece of zinc is put in contact with a piece of copper the oxygen atoms which surround these bodies move slightly away from the copper and approach slightly nearer to the zinc. These slight motions produce the whole Volta effect. All that is necessary for the Volta effect is the inherent film on the surface; all the rest of the gas is mere dielectric and might be substituted by a vacuum.

It was proposed by Prof. Perry, and seconded by Prof. Armstrong, that a meeting should be held to discuss the address.

The meeting then adjourned till February 23rd.

HARTMANN AND BRAUN'S WATT-HOUR METER.*

In apparatus such as alternate current meters, in which a rotating field is used for driving the movable armature, it is possible, as a rule, to put a good deal of iron into the strongly displaced secondary field, and in this case the displacement may be attained in a simple manner, with the aid of connections, in which the field and current are not in the same phase.

The connections of the Hartmann & Braun watt-hour meter are shown in fig. 1, while the instrument itself is depicted in fig. 3.

In fig. 1 a small transformer B is connected with both its

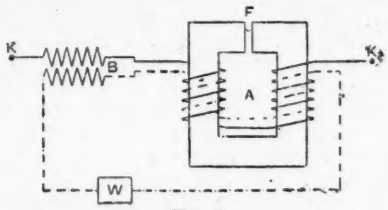


Fig. 1.

coils in series with another transformer A, in which there is a gap F in the magnetic circuit. A small regulating resistance W is inserted in the secondary circuit. The phase conditions are shown in fig. 2, in which O a_1 represents the

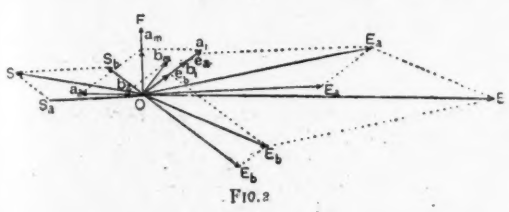


Fig. 2.

primary, and O a_2 the secondary ampere-turns of the transformer A; they produce a resultant O a_m coinciding in direction with the field F of the transformer. O b_1, O b_2, and O b_m are the corresponding ampere-turns of the transformer B. The secondary E.M.Fs., O s_a and O s_b, lag 90° behind O a_m and O b_m respectively. Their resultant is the total secondary E.M.F. The total E.M.F. at the terminals K_1 and K_2 is equal to the sum of the primary terminal E.M.Fs. of both transformers, and is represented by O E, the resultant of O E_a and O E_b. These are obtained by vector addition of the primary inductances and ohmic losses of the transformers taken separately. It is seen that the field O F is displaced more than 90° with regard to the total E.M.F. O E, and by altering W this phase displacement may be adjusted.

The speed of a metallic body revolving in a rotating field is proportional to the sine of the angle of displacement between the two alternating fields. If one of the fields is produced by the supply current J and has the same phase, and the other field is produced by a secondary current i displaced with regard to the supply current, and if, in addition, the lines of force of both are normal to each other and to the axis of rotation of the armature, the speed of rotation of the armature is given by

$$v = \frac{C\,F\,f\,n \sin\phi}{k^2 f^2 + k_1^2 F^2},$$

where n is the frequency, ϕ the difference of phase between the fields F and f, and C, k, k_1, are constants. Since F and f are respectively proportional to the supply current J and the supply E.M.F. E, this equation may take the form,

$$v = \frac{C_1\,J\,E\,n \sin\phi}{(k' v)^2 + (k'_1 J)^2 + D},$$

where D is a damping term depending upon the speed.

If, further, the arrangement is such that the self-damping is as constant as possible for various E.M.Fs., the power remaining constant, and is also small compared with D, and if n is constant, the speed is given approximately by the equation,

$$v = K\,J\,E \sin\phi.$$

If for the field f an arrangement is adopted which displaces it by 90° with regard to E, and if the main current has a displacement $\pm\psi$, then

$$\phi = 90° \pm \psi,$$

and the speed becomes

$$v = K\,J\,E \cos\psi.$$

Since the power expended in the alternating current circuit is J E cos ϕ, we see that the speed is proportional to the power, and the meter is correct under all conditions.

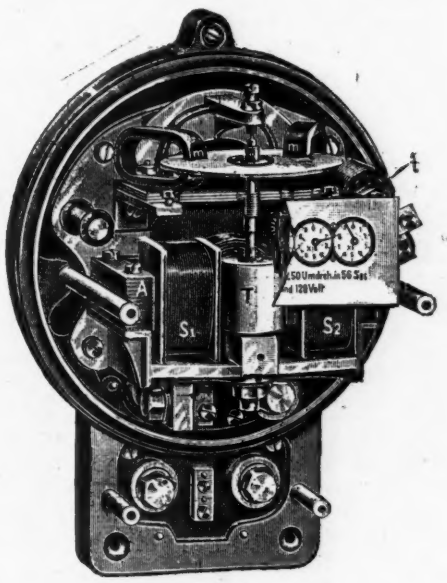


Fig. 3.

In fig. 3 T is the drum-shaped aluminium armature, while A is the magnet of the secondary circuit, and consists of laminated iron. The main current coil lies behind the aluminium drum. The small transformer t is used for obtaining the phase displacement of 90°, while to the left is a resistance for adjusting it. The damping arrangement, consisting of permanent magnets m and an aluminium disc, is in the upper portion of the figure.

THE SPEED OF A CABLE AFFECTED BY THE INDUCTANCE.

Dr. F. Breisig has recently published in the *Elektrotechnishche Zeitschrift* an account of experiments carried out by the officers of the German Government telegraphs on some short lengths of cable manufactured by the firm of Felten and Guilleaume, to ascertain the effect on the signalling speed of putting iron in the conductor to increase the inductance. In the most interesting case a copper conductor, 4·46 mm. in diameter, was lapped with iron ribbon ·16 mm. thick, and insulated with gutta-percha to 11·59 mm. overall. The length of the cable was ·5 kilometre. Several other cables, differently arranged, were also tested, but the one just described was the most important.

The general method employed was to determine the amplitude of the currents passing into and out of the cable due to an impressed alternating E.M.F. of known frequency and voltage, the frequency being varied over a large range. The observing instruments were a telephone and dynamometer. The values of the resistance and capacity of the conductor calculated from the observations corresponded pretty closely with the measures of the same quantities made

* Abstract of article by Johannes Görner in *Electrotechnische Zeitschrift* of October 26th, 1899.

in the usual way, and show that the observations were trustworthy, and the values, calculated for the inductances, could be relied upon.

The figures given are not very easy to follow, as the description of the proceedings is much condensed, and some of the terms are used in senses different to those usual in England; but the principal result seems to be that the inductance of the circuit was increased by 57 per cent. by the lapping of iron wire. The value without the lapping was about ·0024 per kilometre, and with the lapping ·0037 per kilometre.

In the discussion of these results, which we have not been able altogether to follow, it is calculated that an improvement in speed of about 8 per cent. might be obtained by such an iron lapping, but it is difficult to see how any result comparable with this is possible. If the total resistance, capacity, and inductance of a cable be R, K, L respectively, the reduction of amplitude of an alternating current making $\omega/2\pi \sim$ a second, sent from one end and received at the other, is e^m where $2m^2 = K\omega\{(R^2 + L^2\omega^2)^{\frac{1}{2}} - L\omega\}$. $(R^2 + L^2\omega^2)^{\frac{1}{2}}$ is the impedance I. Calling the ratio between this and the resistance p, so that $I = pR$, we have

$$2m^2 = KR\omega\{p - (p^2 - 1)\}$$

In the particular case where the inductance of the cable may be neglected, so that $L = 0$, or where the speed of alternation is very slow, $p - (p^2 - 1)^{\frac{1}{2}} = 1$, and $2m^2 = KR\omega$, a well-known formula. As L increases, or the alternations become more rapid, the value of $p - (p^2 - 1)^{\frac{1}{2}}$ becomes less, till with very large inductances or very rapid alternations the amplitude of the received current would nearly equal that of the sent current.

Now the limiting speed of a cable is reached when the maximum permissible E.M.F. at the sending end produces the minimum readable signal at the receiving end. If the current at the receiving end has an amplitude, Q, the alternating electromotive force at the sending end required to produce that current has an amplitude $QRe^m/2\sqrt{2}m$ units.* If the maximum sending E.M.F. be 10^{10} units (100 volts), and the minimum useful amplitude at the receiving end be 10^{-7} units (1 micro-ampere), then the largest possible value of m is given by the equation—

$$Re^m = 2\sqrt{2}.10^{17}.m.$$

Where as before

$$2m^2 = K\omega\{(R^2 + L^2\omega^2)^{\frac{1}{2}} - L\omega\}.$$

The problem is to determine whether, consistently with these equations, and with such values of R, K, L as occur in ordinary practice, it is possible to obtain a substantial increase of ω by an increase of L of about 60 per cent. (the amount obtained in Felten & Guilleaume's experimental cable), taking into consideration the changes introduced into the values of K and R by the iron lapping. For an example, consider a cable whose length is 4.10^8 cm. (4,000 kilometres, or 2,150 N.M.), with a resistance of 10^{13} units (10,000 ohms), a capacity of 6.10^{-13} (600 microfarads), and an inductance 10^{10} units (·0025 per kilometre, about the amount obtained in the experiments we are discussing). Such a cable corresponds roughly to one of the lighter Atlantic cables. The equation to determine m now becomes

$$e^m/m = 2\sqrt{2}.10^4; \text{ so that } m = 12{\cdot}8, \text{ and } m^2 = 164,$$

and the equation to determine ω becomes

$$55 = \omega\{(1 + L^2\omega^2 10^{-26})^{\frac{1}{2}} - L\omega 10^{-13}\}.$$

If ω_1 be the value of ω calculated on the supposition that L is negligible, ω_2 the value of ω when $L = 10^{10}$ units, the value for an ordinary core, and ω_3 the value of ω when $L = 16.10^{10}$ units, the value when the conductor has been lapped with iron tape, we have

$\omega_1 = 55$ (corresponding to about 95 words a minute).
$\omega_2 = 1{\cdot}054 . \omega_1$.
$\omega_3 = 1{\cdot}086 . \omega_2$.

So that the improvement in the speed effected by the iron lapping is only 3 per cent., supposing this could be done without affecting either the resistance or the capacity. As a matter of fact, if the iron lapping replaces part of the copper, the value of R will be increased (in the case of the cable tried by Felten & Guilleaume by 14 per cent.), and if it replaces part of the gutta-percha, the value of the K will be increased (in the case of Felten & Guilleaume's cable by 8 per cent.) the increase in each case involving a proportionate increase of speed. In either case the loss largely exceeds the gain obtained from the increased inductance.

The question of the effect of absorption of charge by solid dielectrics on the sending speed of cables is referred to by Dr. Breisig. The ordinary insulation test on a cable shows that the charge on the surface of a conductor continues to accumulate for a very long time after the application of the battery, and it has been repeatedly suggested that the charge accumulated during the small fraction of a second between the reversals of a telegraph sending key might reasonably be expected to be smaller than that accumulated during the prolonged contact of the testing key used in measuring capacity with a ballistic galvanometer. As a matter of fact, this effect has not been observed, or at least no observation of it has been published within the writer's knowledge; but Dr. Breisig gives figures showing that capacities measured by rapid alternations up to 260 ~ a second give results concordant with those of the ordinary ballistic method. Considering the commercial importance of the matter, it is somewhat remarkable that so little is known of the behaviour of condensers with solid dielectrics during a short space of time immediately following the application of the battery.—W.A.P.

* See an article on page 190, Vol. xii.

A RECORD PERFORMANCE IN PUMPING ENGINES.

By ED. C. DE SEGUNDO, A M.I.C.E.

A VERY interesting account of a trial of a large steam pumping engine, in the design of which some novel arrangements for heat transfer are introduced, forms the subject of a paper by Prof. Robert H. Thurston, which was presented at a recent meeting of the American Society of Mechanical Engineers. Owing to the new arrangements above mentioned, it seemed probable that the engine might possess a much higher interest from a thermo-dynamic point of view than merely as an exceptionally good pumping engine, and at Prof. Thurston's suggestion arrangements were made for a trial under such conditions as would admit of the scientific study of the engine as a thermo-dynamic machine, with a view to determine the degree to which a real engine at the end of the nineteenth century has been made to approximate to the ideal engine of Carnot.

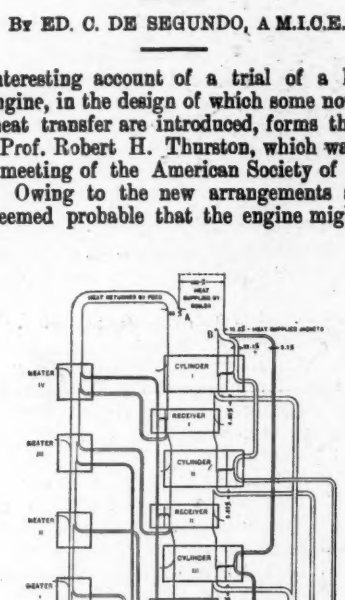


FIG. 1.—HEAT DISTRIBUTION OF THE NORDBERG PUMPING ENGINE.

The absolute or Carnot efficiency of the steam engine is expressed as the ratio of the range of temperature of the cycle to the absolute initial temperature, or $\frac{T_1 - T_2}{T_1}$ where

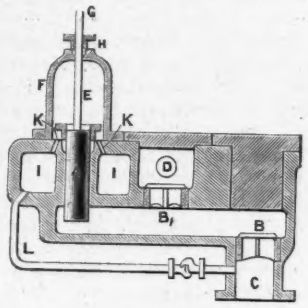


Fig. 2.

T_1 and T_2 are respectively the absolute temperatures at which heat is received and rejected by the engine. The highest degree of efficiency is attained when all the heat is received at the maximum temperature of the cycle and rejected at the minimum temperature; the reduction of temperature in the cycle being produced by the conversion of internal heat into work by expansion, the reverse process obtaining during the period of change from minimum to maximum temperature, *or by some equivalent means.*

An equivalent device, for instance, has been suggested in the introduction of the regenerator principle in the Stirling gas engine, and Cotterill has also suggested a means whereby the efficiency of the steam engine might be improved by a closer approximation to the Carnot cycle. It is a practical application of Cotterill's suggestion that has been introduced in the design of this engine.

The ideal Carnot cycle is one in which the work produced is the difference between that of expansion at constant maximum temperature and that of compression at constant minimum temperature, the work of expansion and compression at decreasing and increasing temperature being the means of changing the temperature within the limits of the cycle without loss or gain of heat. It is unimportant how the temporary storage of energy is effected, whether in a fly-wheel or in a regenerator, provided that all energy stored during the period in which a reduction of temperature occurs, is restored during the period of increase of temperature. The direct balance of heat transfer during expansion and compression is difficult to effect in practice, but if some arrangement could be devised whereby the feed water after leaving the condenser could be heated by steam taken direct from the cylinder during the expansion period in progressive stages, so that the feed water just about to enter the boiler should receive a final accession of heat sufficient to bring it up to the temperature corresponding to the boiler pressure, a more or less complete equivalent of the balanced heat transfers in the ideal Carnot cycle would be arrived at and a proportionate increase of efficiency attained.

Prof. Cotterill in his work on "The Steam Engine Considered as a Heat Machine" has suggested an ideal form of feed water heater consisting of a series of tubular gratings each receiving and discharging the heat to be stored and restored at its own temperature. Such an idea would be difficult to carry out in actual practice, but the application of the principle, although limited, has been found to be practicable, and in the engine tested by Prof. Thurston to have yielded very appreciable results.

From the Sankey diagram (fig. 1) for the heat distribution in this engine it will be seen that by the method of feed heating employed, a portion of the heat in the condensing water is used for this purpose, but the greater part of the heat comes from the jackets and receivers in such wise that heat is imparted to the feed throughout at increasing temperatures.

The engine is a four-cylinder quadruple expansion machine designed by Mr. B. V. Nordberg. The steam pressure is 200 lbs. per square inch, and the pumps work against a head of 600 feet between well and reservoir. The water pressure at the pumps, which are double acting, is about 275 lbs. per square inch. The capacity of the engine is 6,000,000 gallons (U.S.) per 24 hours.

A somewhat unique feature in the design of this engine is that the framing is placed in the middle of the engine, all moving plates being arranged outside the framing. There is only one main bearing extending clear across the engine bedplate, the fly-wheel being clamped on the outside of the crank disc fixed at either end of this bearing.

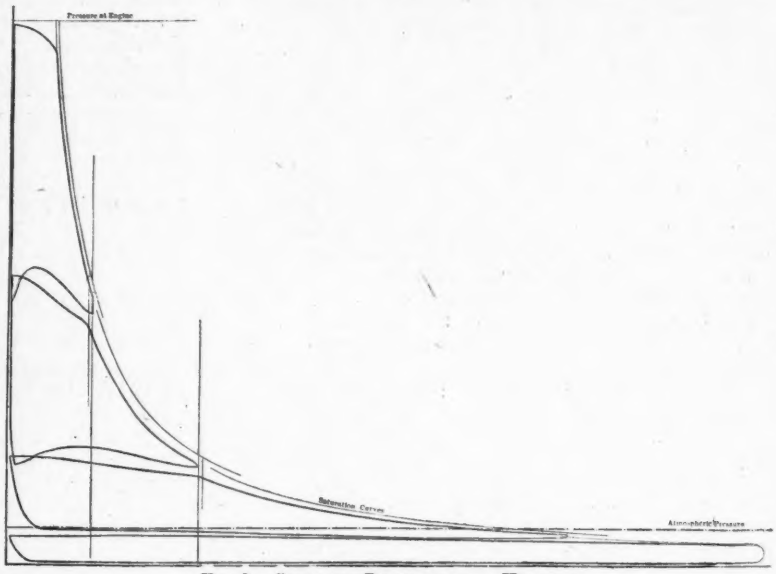


Fig. 3.—Combined Diagram, with Heaters.

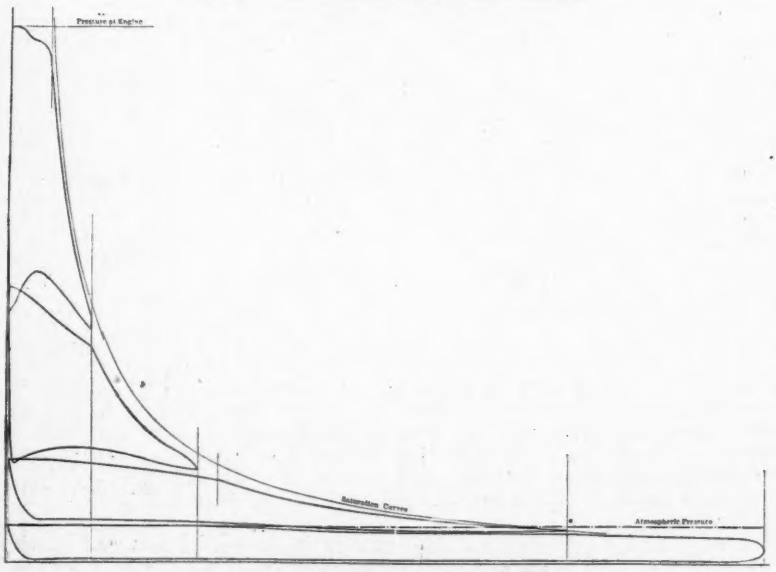


Fig. 4.—Combined Diagram, without Heaters.

Special precautions are taken in the design to prevent loss by radiation and by conduction, the high pressure cylinders being provided at the bottom end with a number of projections which rest on the framing and leave a space between the frame and cylinder covers which is filled with non-conducting material. All the cylinders are steam jacketed on the barrel only. The valve gear is of the Corliss type except No. 4 cylinder valves and No. 3 exhaust, which are of the single beat poppet type.

The pumps used in connection with the heaters have to deal with water at atemperature of over 300° F., and were specially designed for this purpose and merit a detailed description.

Fig. 2 shows the principle in diagram, A is the plunger, B B the suction and discharge valves, C the suction nozzle, and D the discharge nozzle. The pump is single acting. A hood, F, is placed above the plunger, A, the plunger rod, G, projecting through the upper end of the hood, in which is formed a stuffing-box, H. An annular chamber, I, is formed around the main stuffing-box, J, which communicates with the suction nozzle by a pipe connection, L, and a check valve, which opens when the pressure in space, I, exceeds the pressure in suction pipe. The main stuffing-box is packed with duck-packing, the stuffing-box, H, with metallic piston-rod packing. The pressure in the suction pipe, C, is about the same as in the receivers by which the different heaters are supplied with steam. The leakage through the packing in the stuffing-box, J, is caught in the space inside of the hood, F, and the water runs thence through openings into annulus, I. The steam fills the space, E, inside of the hood, and the stuffing-box, H, is thus never in contact with water, but with steam. Whenever the pressure in space, E, and in annulus, I, exceeds the pressure in suction pipe, C, the check valve opens and discharges the water into the suction pipe. By virtue of this arrangement the pressure in E and I is always equal to the suction pressure.

The trial was intended to extend over 48 hours, but had to be stopped at the end of 36 hours, owing to an accident which interfered with the accurate work of observation.

The main results were as follows :—

I.H.P. developed	712
Capacity	6,225,052 gallons per 24 hours against a head of 602·7 feet.
Dry steam per I.H.P.-hour	12 26 lbs.

The steam per I.H.P.-hour is high, comparatively speaking, owing to the transfer of steam from the reheaters to the feed system, and owing, also, to the reduced amount of heat absorbed per pound, the feed temperature being 310° F.

The feed water evaporated per hour amounted to 8,850·4 lbs., and the heat absorbed per pound steam was 909·8 Th.U., or a total of 8,850·4 × 909 8, or 8,052,054 Th.U. supplied per hour.

The work done per revolution was 595,849·49 foot lbs., and the number of revolutions 36·52 per minute, or 2,191 per hour, making 595,849 49 × 2,191 = 1,305,506,232 foot lbs. per hour, or 162,948,824 foot lbs. per 1,000,000 Th.U. supplied. The heat expended was 11,158 Th.U. per I.H.P.-hour, which, together with the work done per 1,000,000 Th.U. supplied, appears to be about 10 per cent. better than the previous best record.

In order to test the influence of the heaters in effecting so satisfactory an economy, a short trial was made without the heaters in use. The work done per 1,000,000 Th.U. supplied sank to 147,525,000 foot pounds, and the weight of dry steam per I.H.P.- hour to 11·4 lbs. It therefore becomes clear that the record duty of this engine is due to the system of feed heating. It should be mentioned that the trial was carried out in September of 1898, the engine having been in use since the beginning of the year. Fig. 3 shows a set of cards from the trial with heaters, and fig. 4 a set without heaters. It will be noticed that the effect of the heaters is to render the saturation curves noticeably discontinuous, as Prof. Thurston has plotted them. The action of the engine is improved, in that the amount of steam taken into each cylinder for equal powers is reduced *with* heaters. The combined diagrams from the four cylinders are interesting.

The records established by the Nordberg engine are most interesting, and demonstrate that a substantial advantage in economy can be gained by an equivalent transfer of heat from the expansion to the compression side of the diagram, on the principle described by Prof. Cotterill. Summarising these results, we get :—

Foot-pounds per 1,000,000 Th.U. supplied ...	163,000,000
British thermal units per I H.P.-hour	11,160
Efficiency compared with perfect engine of Carnot	84 per cent.

The above figures and efficiencies are calculated on the basis of heat supplied to the engine. In other words, the boiler is left out of account altogether. From a thermodynamic point of view this is, of course, perfectly legitimate, but, after all, the kind of efficiency that manufacturers and other users of steam engines have to deal with is the efficiency represented by the proportion of what you get to what you pay for. In most cases coal is the fuel used for the production of steam-power, and in computing the economic value from a commercial point of view, due regard must be had to all circumstances and conditions bearing upon the money outlay per horse-power-hour. The evaporative performance of standard types of boilers is pretty well known, so that as far as the boiler is concerned, the conclusions to be deduced from the above results would not be materially affected, but a glance at the diagram of steam connections, hot water returns and heaters which accompanies Prof. Thurston's paper, show that the economy is purchased at the expense of simplicity in design, and the question that immediately suggests itself is whether or not the increased economy is more than counter-balanced by the increased cost of maintenance, repairs, &c., due to the increased number of parts in the engine. Of course, such engines as the one described here can have but a limited application, and, although scientifically the results obtained are of extreme interest, it is doubtful whether the design of the average engine for average purposes will be much influenced thereby.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Pa Agents, 322, High Holborn, London, W.C., and at Liverpool, Mancheste and Birmingham, to whom all inquiries should be addressed.

1,813. "Improvements in filaments for electric incandescence lamps.' Lake. (R. Arno, Italy.) Dated January 29th.

1,825. "Improvements in dynamo-electric machines." B. G. Lamme. Da January 29th. (Date applied for under Patents Act, 1883, June 30th, being date of application in United States.)

1,842. "Improvements in or connected with incandescent electric lamps G. Davis. Dated January 30th.

1,863. "Improvements in coils or helices for electrical purposes." W. G. Heys. (J. Scott, R. Varley, and J. C. Anderson, United States.) Dated January 30th. (Complete.)

1,864. "Improvements in and relating to the method of winding coils or helices for electrical purposes." W. G. Heys. (J. Scott, R. Varley, and J. C. Anderson, United States.) Dated January 30th. (Complete.)

1,869. "Improvements relating to electric arc lamps." H. A. Couchman. Dated January 30th.

1,886. "An improved arrangement of switching appliances for use with telephones." H. E. Newton. (P. Rabbidge, New South Wales.) Dated January 30th. (Complete.)

1,906. "An improved electric pendulum clock." F. Haenichen and O. A. Haenichen. Dated January 30th. (Complete.)

1,937. "Improvements in or connected with overhead collectors for electrically-propelled railway vehicles." R. J. Urquhart and H. Goodwin. Dated January 31st.

1,990. "Improvements in means for producing and detecting or observing electrical waves or oscillations." J. Y. Johnson. (G. F. Hatton, France.) Dated January 31st.

2,022. "Improvements in the insulation of electric cables." G. E. Heyl-Dia. Dated February 1st.

2,040. "Improvements in the system of electrical distribution." B. Hopkinson. Dated February 1st.

2,047. "Improvements in automatic switches." A. Eckstein and D. B Mellis. Dated February 1st.

2,050. "Improvements in controlling electrically-propelled vehicles." E. H. Tyler. Dated February 1st.

2,062. "Improvements in arc lamps." H. Bourne. Dated February 1st.

2,077. "An improved accumulator battery." V. Cheval and J. Lindeman. Dated February 1st. (Complete.)

2,079. "Improvements in electrical condensers." G. F. Mansbridge. Dated February 1st.

2,104. "Magnetic electrical surface contacts for electrical trams and light railways." W. F. Stamp. Dated February 2nd.

2,109. "Improvements in or relating to electric cables." Dated February 2nd.

2,119. "Improvements in or relating to junction boxes for electric conductors." L. M. Waterhouse and The Simplex Steel Conduit Company, Limited. Dated February 2nd. (Complete.)

2,120. "Improvements relating to electric switches." L. M. WATERHOUSE and THE SIMPLEX STEEL CONDUIT COMPANY, LIMITED. Dated February 2nd. Complete).

2,142. "Improved means for controlling and regulating the consumption of electric current on light and power circuits." I. ALEXANDER and C. BANNISTER. Dated February 2nd.

2,150. "Improvements in telephone transmitters." G. DALLAIRE. Dated February 2nd. (Complete.)

2,159. "Improvements in apparatus for electro-plating pins and other small objects." E. MORRISON. Dated February 2nd.

2,178. "Improvements in electric stopping mechanism for drawing or slubbing frames." F. ARROWSMITH and HOWARD & BULLOUGH, LIMITED. Dated February 3rd.

2,176. "Improvements in regulating mechanism for arc lamps." A. ECKSTEIN and A. E. ANGOLD. Dated February 3rd.

2,191. "Improvements in electric brakes." C. W. HILL. Dated February 3rd.

2,213. "Improvements in electric arc lamps." W. PERITZ. Dated February 3rd.

2,219. Improvements relating to the measurement of electric power and energy." R. ARNO. Dated February 3rd. (Date applied for under Patents, &c., Act, 1893, Sec. 103, July 5th, 1899, being date of application in Italy.)

2,222. "Improvements in electricity meters." A. WRIGHT and THE REASON MANUFACTURING COMPANY, LIMITED. Dated February 3rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 323, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

9,561. "Improvements in the means for controlling carbon feeding mechanisms for electric lamps." W. D. Hunter. Dated April 14th, 1897. Relates to brake mechanism for arc lamps. The upper carbon is carried by a rack which slides in a slotted central tube and engages a pinion on the shaft of a brake pulley. This shaft carries two loose links supporting a brake lever, the unequal ends of which are attached to the ends of a brake strap surrounding the pulley. The brake lever may rest on an adjustable stop, in which case the strap frees the pulley so that the upper carbon may fall. The lever is lifted by a link connecting the links and a regulating lever when a core is attached to this is raised by a series solenoid, a dashpot regulating the motion; the strap then grips the pulley and raises the upper carbon. The regulating lever is made as an open frame. In a modification, the links are dispensed with, the brake lever being fulcrumed on the regulating lever and the brake wheel supported co-axially with this. In a further modification, the brake lever is also dispensed with, the ends of the brake strap being attached directly to the regulating lever at unequal distances from the axis of this lever, which is eccentric to the brake pulley. 3 claims.

9,587. "Improvements in electric measuring instruments." Evershed and Vignoles, Limited, and S. Evershed. Dated April 15th, 1897. Ammeters and voltmeters such as those described in Specification No. 20,728, A.D. 1893, wattmeters and similar instruments, especially those having horizontal axles for use on switchboards, are provided with air damping vanes and boxes to prevent oscillations. In the form described the axle carries a sleeve with two rectangular vanes within a closed circular box, which has partitions, only small clearances being left about the vane for the passage of air. The box may form part of the frame of the instrument, being closed by two semi-circular plates and carrying the scale in front and supporting the coil, &c., on its back. In a modification, each vane carries a segmental extension within an annular channel around the partitions to afford more obstruction to the passage of air. In other modifications the sleeve carries four vanes between four radial partitions or two vanes movable through nearly 180° between two partitions, or one vane may be used with a single radial partition, this arrangement allowing the axle to make nearly a whole revolution. 1 claim.

13,422. "Improvements in coin freed mechanism for electric lighting of vehicles." O. Imray. (La Societe Anonyme d'Etudes et d'Exploitation de l'Accumulator "Eclair.") Dated May 31st, 1897. Electric lighting is provided for hired vehicles. The light is given on the introduction of a coin, and is maintained until a door is opened, or, on introducing a second coin, until clockwork is run down. One form of the apparatus when the light is in circuit through a bell crank and a hook which extends from a slide operable by hand after a coin has been inserted to disengage a catch from a pin thereon is described. The slide, having been pulled out and pushed in, has brought a bell crank up from the left by means of the hook, and the retaining pawl has made the hook shift from an insulating notch in the bell crank to electric contact with the metal of the bell crank. To ensure the continuance of the light for a given time, a second coin is paid, and the slide is again operated, whereby, while the bell crank is merely rocked to the right and back again to the position shown, a switch wheel is turned so as to make the circuit by another route, and is left to reverse slowly under the control of clockwork. If, before paying the second coin, or after the given time has expired, the door of the vehicle is opened, a shunt containing an electro-magnet is closed, and the electro-magnet breaks both the shunt and the main circuits by lifting the two latches, whereupon the bell crank is tilted to the left by its spring and catches the falling latches by its insulating notch, thus keeping the lamp circuit open till another payment and operation have occurred. The bell crank in this position holds the timing gear out of engagement with the operating slide. 2 claims.

13,520. "Improvements in pneumatically-worked electric switches." Siemens Bros. & Co., Limited, and A. E. Rossignol. Dated June 1st, 1897. Relates to means for controlling pneumatically-operated switches so that contact is made and broken in a predetermined order as for starting electric motors. A number of pneumatic cylinders are arranged side by side, each having a vertical slide valve. The piston rod carries a contact piece adapted to complete the circuit. The exhaust is connected to ports so as to assist in blowing out an arc. Each piston rod is extended and carries a projection working in a guide-slot in a sliding piece. The slide valves carry pins working in slots in a slide working in or with the sliding piece. The slide valves are thus operated when the slide is moved by a rack and pinion, &c., while the pistons can only move when the vertical slots are in line with the pin. A handle is provided for operating the pistons by hand. In a modified form the cylinders are disposed in a circle, and the slides are correspondingly arranged and operated by a suitable handle. 1 claim.

13,522. "An improved starting switch with automatic cut-out for electric motors." H. H. Cutler. Dated June 1st, 1897. Relates to a starting switch for motors, and to a cut-out which operates should the current fail or become abnormally high. The contact arm is of magnetic material, and in normal working is held, with the resistances cut out, by the magnet or solenoid in series with the field coils of the motor. A second electro-magnet in series with the armature of the motor is fitted with an armature carrying contacts which are adapted to engage with contacts and short circuit the magnet. The magnet is so adjusted that his short circuiting only occurs with abnormal currents. The arm is then released, and under the action of a suitable spring, passes over the contacts of the resistance switch, and so cuts out the motor. In a similar manner the magnet releases the arm should the current fail. 4 claims.

13,524. "An improved starting switch with automatic cut-out for electric motors." G. A. Mower. (H. H. Cutler.) Dated June 1st, 1897. Relates to a starting switch for motors, and to a cut-out which operates should the current fail or become abnormally high. The contact arm is held in any desired position on the contacts of the resistance switch by a pawl on the armature of the electro-magnet engaging a toothed segment. The magnet has two windings, one being opposed to the other. Normally, one of the coils is short-circuited at the mercury contacts and the armature is held in position. Should the current become abnormally high, contact is broken at the mercury contact by the action of the magnet in the circuit, and the coils of the magnet then neutralise one another. The contact arm is thus released, and swings over to break the circuit by the action of a suitably arranged spring. 5 claims.

13,532. "Improvements in windings for the armatures of direct current dynamo-electric machines." V. A. Fynn. Dated June 1st, 1897. Armatures; sparking, preventing.—In a slotted or tunnelled armature, which may be either of the drum or ring type, the active wires on each side of the same spool of the winding are distributed into two or more adjacent slots or tunnels in the armature core and connected in series. The object is to reduce the armature reaction and consequent liability to sparking. 1 claim.

13,564. "Improvements in and relating to electric motors and dynamo-electric machines." S. H. Brown. Dated June 2nd, 1897. A field-magnet is provided with two exciting coils, which completely surround the armature and cross each other at or near the middle of each of the coils. The magnetic poles are introduced through the spaces formed between the coils at the top and bottom, and the magnetic circuit is completed by the outside case. 4 claims.

13,594. "Improvements in or relating to electrical meters, applicable to prepayment electrical meters." C. O. Bastian. Dated June 2nd, 1897. A voltmeter consists of a glass tube having an enlarged part containing electrodes by which the main current is conveyed through acidified water in the tube, the quantity passed being measured by the fall of the surface of the liquid as indicated by a scale. Oil may be put in the surface of the liquid to prevent evaporation. The tube may be of U-form as shown; it may be in two parts, the bent portion being connected by an India-rubber plug to the wide part. In this case a loose India-rubber diaphragm may be placed over the plug, to separate the two limbs so that coloured liquid may be used in the second limb. The meter may be provided with coin-freed mechanism. For this purpose the limb of the tube contains a float with a bent wire, which may make contact with a weight carried by a flexible conductor. This closes a shunt circuit through a magnet which moves an armature and catch to release a spring arm, so that this opens the main circuit at two mercury cups. The weight may be moved down a certain distance by turning a handle, after insertion of a coin between radial plates carried by discs on two aligning shafts, one carrying the handle and the other a wheel to which the flexible conductor is connected. The turning is controlled by a strong spring bearing on a triangular cam on the pulley-shaft, the disc on which carries three pairs of radial coin plates. The pulley shaft also carries a triangular cam which acts on the spring attachment to the arm to move this down and close the circuit. The arm is then held by the catch until by the passage of sufficient quantity the float and wire again close the shunt circuit through the weight. The provisional specification states that the voltameter and contacts may be used with coin apparatus described in Specifications Nos. 2,224 and 16,342, A.D. 1896. 6 claims.

13,599. "An improved self-acting mule with electrical driving gear." W. Bretschneider and W. Lauth. Dated June 2nd, 1897. The mule is driven by means of an electric motor which is mounted loosely on a tin roller shaft, and may be coupled directly to it by means of a clutch when drawing out, and through gearing and a clutch when backing off. A pulley on the motor is connected by a band with a pulley on the rim shaft. The drawing-in and winding-on operations are effected in the usual manner through a countershaft connected by gearing with the tin roller shaft. 2 claims.

13,617. "Improvements in and connected with electric arc lamps." J. Brockie. Dated June 2nd, 1897. Arc lamps are provided with improved brake mechanism and carbon guides. In the focussing lamp the carbons are carried by brackets sliding on tubes, the lower parts of which are slotted to receive the angle of the lower holder, and an enlarged end on the upper one. The angle of the upper holder and the outer ends of both, are forked to embrace the tubes. The upper carbon is insulated from its bracket, connection being made with it by a flexible conductor. The brackets are hung from a pulley, the upper one being heavier. The pulley is situated between two vertical electro-magnets, which act separately on armatures on two levers; these are carried by short shafts supported between centres and immediately below the magnets, so that the magnetic pull on them is partly balanced. The pulley, magnets and levers are supported in a single metal frame. One magnet is in series with the carbons and its lever is connected to one end of a brake chain, the other end of which is held by a spring. The other magnet is in shunt with the carbons, and its lever is connected by a pin and slot to the lever, so that when both magnets are in action, the shunt magnet opposes the action of the series one. Or the levers may be rigidly connected. The pulley is also controlled by a spring brake, and consists of a cord attached at one end to an arm, and at the other to a spring on this arm. The arm is loose on the pulley axis, but its motion is limited by stops. It thus turns freely with the pulley when the arc is struck, but retards the feeding movements of the pulley. In a modified arrangement of the spring brake, the arm carries two shoulders enclosing the pin of the series lever, in such a way that the action of the spring brake further assists that of the main brake. A non-focussing lamp of similar construction is described, in which the upper carbon is fixed, while the lower one is carried by a bracket as described, supported by a cord connected to the pulley, which in this case is provided with a drum containing a coiled spring to draw up the lower carbon. The regulating mechanism is similar to that before described; both magnets may be connected as shunts to the carbons and both act on one armature lever. 8 claims.

13,678. "Mechanism for operating the bells of cars or carriages of electric or other railways." J. Terry-Haskins. Dated June 3rd, 1897. The bell is attached to the under side of the floor of an electric rail or tramcar and has two hammers. The latter is operated by an electro-magnet arranged in circuit with the main circuit of an electric car or with some suitable source of electricity. The circuit is completed by the driver stepping on a spring, depressing a pin and causing the outer end of the lever of the hammer to make contact between fixed plates by means of contact plates. When the foot is removed the hammer falls, breaking the circuit. The hammer may be operated to strike the gong by pressing on a push pin, such arrangement being useful when the current is cut off as in going down hill, &c. The arrangement may be used on non-electric tracks by providing a source of electricity, and the push pin may be dispensed with. 3 claims.

13,717. "Improvements in or relating to switches for starting resistance for electric motors and other cases where resistances are required." J. W. Gibbs. Dated June 3rd, 1897. Switches for motors, &c., so arranged that the circuit cannot be made or broken unless there is the required resistance in the circuit. A double-pole switch, fitted with a tongue or projection which forms part of the interlocking gear is shown. The other part consists of a disc carried by the resistance switch. This disc is fitted with a slot in which the projection can work when the switch is turned to put the maximum resistance in the circuit. When the switch is "on" the projection is below the disc, and the resistance switch can be turned by the handle and gearing. The handle is fitted with a plate, which closes the slot when "on" and also engages with a catch to prevent the movement of the cover. 2 claims.

14,341. "Improvements in machines for making carbons for electrical purposes." H. H. Lake. (T. S. Dooley.) Dated June 12th, 1897. A mixture of gas coke, sulphuric acid, treacle and graphite is placed in a cylinder through an aperture

and is forced by a piston into dies or mould tubes which are fitted with screwed caps with radial apertures. The open ends of the tubes are closed during the pressing operation by a vertical sliding plate, reciprocated by a cam and rod. When the plate is in its lowest position the moulded carbons are forced out of the tubes through apertures in the plate and a cross bar on to a corrugated carrier train supported by endless chains passing round sprocket wheels. The tray is fed forward step by step, by a crank pin, a star wheel, a sprocket wheel, and an endless chain. The cross bar is attached to sliding side bars which are operated by toggle joints, links and eccentrics so as to cause the cross bar to bear against the plate during the pressing operation, and release the plate when it slides from one position to another. Core rods are threaded through the tube caps when it is required to produce tubular carbons. For solid carbons the cores are dispensed with and the bores of the tubes are steeped or reduced to ensure the compression of material. The main shaft is operated by a hand wheel, which, by means of a pin and rod or cam, automatically shifts the valve of a hydraulic engine which actuates the piston. 6 claims.

14,397. "Improvements in the generation and utilisation of hydrogen gas by electricity for motive power, lighting, and heating purposes." L. H. Wattles. Dated June 14th, 1897. A number of galvanic batteries are employed, and the hydrogen generated is used to drive a gas engine, or it may be collected or carburetted, while the current obtained is used to drive an electric motor, or used for heating or lighting purposes. Each cell consists of a copper cell inside which is a holder for supporting the zinc electrode which is covered by a gas collector leading the evolved hydrogen to an outlet. The liquid such as sulphuric acid and water in any desired proportions, is charged through the stoppered openings in the cover to the height. The cells may be combined in series, and the hydrogen outlets united together to form a tube. The hydrogen may be led direct to the gas engine, or may be passed by the pump to the gas holder, or to the carburettor, suitable valves being provided. The current is led to the motor which assists to drive the crankshaft of the gas engine, or both motor and gas engine may drive the the shaft. The conductors are provided with a fuse, switch, resistance box and switches. By means of the switches the current may be used for lighting purposes as indicated by the lamp, for heating purposes as indicated by the coil, or be led to an induction coil, the secondary of which is led to the gas engine for igniting the hydrogen. For this purpose the conductors are connected to the terminals and the circuit is made whenever the points are in contact, but when the piston to which the point is attached makes its outward stroke, a spark passes and ignites the hydrogen. 2 claims.

14,421. "Improved apparatus for supplying or measuring a current of electricity." W. D. Watson and T. Humphreys. Dated June 15th, 1897. A cam-lever which is oscillated by a clock in a coin-freed meter described in Specification No. 11,045, A.D. 1897, to cause oscillation of the escapement of a registering mechanism, is stopped in various positions in accordance with the current passing through a thermal ammeter. In one form the current passes through a wire stretched between fixed supports, and the stop lever is held against the wire by a spring. In another form, the lever is replaced by a blade spring fixed at its lower end and connected by cords with a sagging wire. 1 claim.

14,469. "An improved compound for waterproofing and other purposes, applicable also as an acid resisting and insulating material for electric cells." C. Baswitz. Dated June 15th, 1897. Asphalt, stearine, paraffin, ozokerit, vegetable wax, or the like is mixed with vaseline. The mixture is used for waterproofing cotton or linen fabrics for wearing apparel, tents, awnings, &c. Suitable fatty aniline colours may be added to the mixture for producing coloured fabrics. As the mixture is an insulator and resists acid it may be employed in conjunction with asbestos, &c., for coating battery cells and for like purposes. 1 claim.

14,475. "Improvements in systems of distribution of electricity." The British Thomson-Houston Company, Limited. (E. W. Rice.) Dated June 15th, 1897. Relates to the distribution of electricity, particularly for a three-wire system applied to electric railways as described in Specification No. 19,861, A.D. 1895, when urban sections are worked on two-wire systems. To compensate for the drop of potential on the two-wire sections a shunt wound motor and resistance are coupled between the negative and neutral wires of the three-wire section and drives a series wound generator which is in series with the main, one feeder passing beyond the insulator to the two-wire section. 6 claims.

14,476. "Improvements in insulators for electric conductor rails and feeders." The British Thomson-Houston Company, Limited. (S. H. Libby.) Dated June 15th, 1897. In third-rail systems the third rail may be bevelled at the edges and rest on a rotating collar provided with clipping lugs. The collar fits on to a conical insulator mounted on a shank carried by a cross support. The clips may engage the lower flange of an ordinary rail, in which case the cross supports are bent downwards to allow room for the insulator. Feeders are attached to the rails by extension pieces soldered to the end of the feeder. The end of the feeder is stepped, and an outer sleeve is filled with plastic insulation, an insulating cap being afterwards applied. 9 claims.

14,477. "Improvements in and relating to insulators for electric conductor rails." The British Thomson-Houston Company, Limited. (S. H. Libby.) Dated June 15th, 1897. Insulators for the conductor rails of a third-rail system are formed of pairs of blocks of insulating material carried by arms, and supporting the rail between them. Sheet lead is placed between the rail and the insulator. The arms are rounded at the ends and engage in recesses in the insulator; or both arms and insulators have holes to receive a bolt, which passes through both, and also an elongated hole in the web of the rail. One or more recesses and arms may be used in each insulator. Guard planks are supported on arms. 8 claims.

14,478. "Improvements in electric meter apparatus." E. Oxley. Dated June 15th, 1897. In order to accurately register small loads in a system on which the load is sometimes large, two meters of different sizes are used. The smaller one is permanently in circuit. The circuit also includes the coils of an electromagnetic switch, which connects the large meter in parallel with the small one, if the current passing is sufficient to close the switch. The small meter may at the same time be cut out. Two suitable forms of switch are described. In that shown, the electro-magnet acts on an armature carried by a spring-held lever, which carries forks to connect mercury cups when the current passing is sufficient. In the second switch the electro-magnet acts on an armature on a spring-supported frame. When depressed this presses down flexible diaphragms, and forces mercury enclosed below these into contact with terminals, thus making connections with the second meter. 3 claims.

14,520. "Improvements in and relating to electric and other auto-cars." H. H. Leigh. (Societe Charles Mildé fils et Compagnie, R. Mandro and A. Courtant.) Dated June 15th, 1897. Relates to electric and other auto-cars. The body of the vehicle on which the accumulators are carried is supported on a system of steep springs and India-rubber blocks, and the wheels are furnished with pneumatic or other elastic rubber tyres. The motor is designed to provide for differential driving of the wheels when the vehicle is travelling in a curvilinear path. It is constructed with two independent armatures and the field magnet is wound so that half is in series with one of the armatures and half in series with the other armature. The armature shafts drive a pair of countershafts from which motion is communicated to the road wheels through articulated lengths of shafting. The control of the motor is effected through the medium of a pair of barrel switches, which interlock by an arrangement resembling the Geneva stop, so that a wrong action of the driver is rendered impossible. A cut-out switch is also arranged to be operated by the brake lever whenever the brake is put on, which can be closed again only when the controlling switch is in the "off" position. 8 claims.

14,568. "Improvements relating to electrically lighted devices for advertising and other purposes." E. L. O'Brien and L. Grant. Dated June 16th, 1897. Electric lamps of different colours forming devices for advertising and other purposes have, on being switched on and off, a gradually increasing and diminishing resistance thrown into the circuit of each lamp so as to cause it gradually to diminish or increase in brilliancy. The movable contacts connected with such a lamp are mounted on an inclined disc which rotates so as to cause such contact thereon to be immersed in the liquid, and gradually approach the fixed contact and then recede from it until it finally emerges from the liquid. In a modification the movable contacts are mounted on revolving arms. 3 claims.

14,741. "A new or improved electric alarm apparatus for clocks." G. H. Skee. Dated June 18th, 1897. The circuit of an electric bell is completed at particular hours on particular days of the week as pre-arranged. Cams on the hour-arbor drop contact-wires at the hours to touch a wire lifted for the day by a wheel having seven lifting-pins of different lengths, and 14 equal pins for gear with an arm on the hour-arbor. 1 claim.

20,394. "An improved arrangement for strengthening electric currents." M. R. V. Leon. Dated September 4th, 1897. Relates to arrangement of apparatus for the purpose of strengthening continuous currents of electricity. In the following arrangement a generator and work circuit is provided, also a ball having one or more points supported near the ground and connected with a Geissler tube which is connected to the generator. A second ball is also provided, supported at a considerable distance above ground and connected to a second Geissler tube. The first ball may be directly connected to the ground but not to the Geissler tube. In the modified arrangement the high level body is connected through a condenser to the low level, and acts upon the generator circuit through a transformer. In another form the balls are dispensed with, and a coil is arranged round an iron core having a number of points on its free ends. 4 claims.

20,398. "An improved electric meter for alternating and continuous currents." P. R. Blondlot. Dated September 4th, 1897. The current to be measured passes through fixed and movable coils in series, by cups of mercury covered with glycerine, the movable coil being supported on a point. The current turns the movable coil into the plane of the fixed one each movement being assisted, when the movable coil is near this neutral position, by an iron pin on an arm of it approaching a stationary bar magnet. In the neutral position another arm makes contact with a spring closing the exciting circuit of an electro-magnet. Normally, a spring supported armature presses the spring against a fixed support; but, when the contact is made, the armature is withdrawn by the electro-magnet, freeing the spring, which, acting on the second arm, causes the movable coil to oscillate. At the same time a pawl on the armature moves a ratchet wheel and counter a step. During the passage of current the movable coil thus oscillates continually, the time of each oscillation varying inversely as the current strength. The effect of the bar-magnet is to ensure that the spring acts so that the coil is thrown to a position from which even a weak current can return it. 4 claims.

20,444. "Improvements in and relating to telephones." C. Junge. (C. Kraft, C. Huber, and J. Exner.) Dated September 6th, 1897. Relates to apparatus for use at a subscriber's station when either alternating or continuous currents are employed. A telephonic receiver is constructed with the two magnet coils set one on each side of a diaphragm and supported by bridge pieces either formed as part of or attached to horse-shoe or circular polarising magnets. The diaphragm has a thick edge and may be of non-magnetisable metal provided with a radial tongue of iron polarised by one of the magnets. The diaphragm may also be made of iron in segmental or circular form with a thickened edge. The transformer employed has horse-shoe cores of iron wire connected by a yoke piece and primary and secondary coils on each arm. A commutator for sending the alternating calling currents is connected to the primary circuit of the transformer and consists of an insulating cylinder with three sets of contacts in similar positions, and the first alternates midway between them. The contacts are rubbed by brushes. A triple cam and its pressure roller hold the cylinder so that normally the brushes rest on the first contacts. 5 claims.

20,449. "Improvements in current conducting rails for electric railway systems." L. E. Watkins and G. M. Jowett. Dated September 6th, 1897. Conductors or third rails are made of iron or steel with their tread covered with copper. 3 claims.

20,455. "An electric igniter for internal combustion engines." P. Jensen. Dated September 6th, 1897. In a chamber communicating with the cylinder are electrodes which may be inspected or removed by removing a plug. The fixed electrode is carried on a rod secured in a sleeve surrounded by insulation. The movable electrode is on a rod and is pressed against the fixed electrode by a tappet engaging a spring attached to a block on the outer end of the rod. When the incline on the tappet, riding upon a roller in the fixed bracket releases the spring, the electrodes fly apart and an arc is produced between them. The block is steadied by a spring blade fixed to the bracket. The tappet may be turned on its rod so that for normal running a different incline may be used from the one used at starting. 3 claims.

20,486. "Improvements in and connected with the electro-deposition of copper and other metals on rotary cathodes." W. E. Heys. (The Electrical Copper Company, Limited.) Dated September 7th, 1897. During the electro-deposition of copper and other metals upon rotary cathodes by a known process, the cathodes are rubbed by animal skins, intestines, and other similar animal and vegetable matters consisting of or containing gelatine, fibrine, albumen, &c., freed from greese or fatty matters. This invention consists in treating these "impregnators" before use with substances, such as alkaline bichromates or chrome alum, which render the gelatine, &c., insoluble. 1 claim.

20,493. "Improvements in and connected with the transmission of energy by alternating currents." C. S. Bradley. Dated September 7th, 1897. In alternating current distribution over long lines, in order to overcome the trouble due to the capacity of the cables, inductances are arranged at intervals. The value of the inductance is calculated, according to a given formula, to make the line resonant with the impressed electromotive force. 2 claims.

20,496. "Improvements in surface contact electric railway systems and in apparatus for use therewith." The British Thomson-Houston Company, Limited. (W. B. Potter.) Dated September 17th, 1897. Electric railways and tramways on a road contact or sectional conductor system with electro-magnetic switches. Conductors; switches.—Two sets of road contacts are placed alternately, one set being connected through the coil of the magnet to the return rail, and the other set to contacts in two adjacent switches, of which the third contact is connected to the feeder. Current for picking up the switches, or for holding them up when the motor circuit is broken, is supplied by a battery arranged as shown or otherwise, or by a small magneto-electric machine driven by hand, or through a rack gearing from a treadle. The driver's switch may have an extra contact to maintain the circuit when the motors are cut out. 14 claims.

20,501. "Improvements in and relating to surface contact or closed conduit electric railways." The British Thomson-Houston Company, Limited. (W. B. Potter.) Dated September 7th, 1897. Electric railways and tramways on a road contact, or sectional conductor system with electro-magnetic switches. Conductors; switches.—To cause the opening of the switches by leakage currents, the contacts which supply current to the motors or those by which the switches are operated, are surrounded by, but insulated from, metal boxes or bands which are connected to the return through differential coils or additional magnet coils to open the switches. The safety coil for each contact may be in its own switch only, or adjacent switches may also be connected, preferably with separate ground connections. 1 claim.